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Edison Two-Lamp Pressure Indicator.

This instrument represents the latest improvement in the type of pressure indicators which are so successfully used in connection with Edison plants. It being found that the carbon filament in the lamp on the one-lamp pressure indicator changed in time as it was burned, it became necessary to recalibrate the indicator, in order to maintain correct indications. It became necessary then to put in the instrument a means by which the engineer operating the plant could quickly and easily restandardize his instrument.

This improvement virtually consists in connecting two indicators through a switch

to the same points in a circuit, using one as a working indicator to be kept constantly in circuit, while the other should be kept out of use until such time as it is thought necessary to throw it in, in order to check the other. This is done in one instrument by putting on two lamps and two sliding resistances, and so connecting them with a switch, that when one lamp is lighted, one slider is to be used, and when the other lamp is on, the other slider is in use.

In the two-lamp pressure indicator, as shown in the illustration, the "test" lamp is the one to be kept for a check, while the "work" lamp is to be burned.

New York Wires.

The General Laws Committee of the Senate made a report last week on electric matters, recommending that all wires in New York city, and in all cities of over 125,000 population, be put underground by Jan. 1, 1892, and that they be subject to some such control as is now exercised over steam boilers.

As to alternating and continuous currents, the committee finds that both can be made safe.

The committee will soon report a bill in conformity with its recommendations.

Accidents from Gas that Pass for Suicides.

Deaths by gas asphyxia have of late been more than ever frequent, according to the New York *Sun*. They outnumber electric fatalities more than ten to one, but coming singly, and without the startling features of an electrical accident, they attract little attention. One reason for the lack of popular interest is the fact that in fully half the cases reported to the coroner's office there is a presumption of suicide, and in most such instances the doubt is never cleared away.

As a matter of fact, there is no doubt that many cases recorded as "suicide" or "blew out the gas," have been accidents, pure and simple. Some of them have their explanation in a common defect of gas fixtures, which the coroners and police usually fail to look for. If you will take the trouble to examine a gas cock you will notice there is a pin driven in the side of the plug to stop its revolution when the gas has been turned off. Consider what will happen if this pin has dropped out or is broken off. The gas is turned off, the light goes out, but, there being nothing to arrest the hand, the plug revolves too far and the gas is again turned on. If the person who is just going to bed happens to drop asleep before the odor of escaping gas becomes noticeable, or if he is intoxicated, the coroner's office will report another case of suicide or blowing out the gas.

This is one of the most common defects in gas fixtures, and one which in cheap hotels and lodging houses can be discovered on an average of one in ten gas fixtures, so dealers in gas fixtures who make repairs, say. It is a most culpable negligence which allows such defects to exist, and, by the way, an excellent cause of action would lie against the proprietor of any hotel where a guest suffered by such a fault.

Coroner Levy, when his attention was called to the matter, said he intended to make special inquiry on this point in cases of gas asphyxia which hereafter came before him. The matter had never been investigated before, but it was a point, he agreed, which would sometimes settle the whole question of accident or suicide in a disputed case.

Kansas Falls Into Line.

An important meeting was held last week at Topeka, Kan., for the purpose of forming a State association of central station companies engaged in the business of selling electric current for light, heat or power. An organization was perfected by the adoption of a constitution and by-laws, and the election of an executive committee and the following officers:

L. A. Beebe, Hutchinson, Kan., president.
G. F. Parmelee, Topeka, Kan., vice-president.
J. C. Fuller, Winfield, Kan., vice-president.
R. C. Johnston, Lawrence, Kan., secretary and treasurer.

The name adopted is the Kansas State Electric Association, and its objects, as set forth in the constitution, are:

"To promote the legitimate growth of business; the securing of uniformity in regulations for inspection of construction and inside wiring; also underwriters' rules for insurance; and to give such assistance and advice to the companies in its membership as may be consistent with the general interests of the industry, and the benefit of consumers."

Charles T. Yerkes has purchased an electric fountain, and will present it to Lincoln Park, Chicago. It cost $23,000, and is now on the way from New York. There will be no statuary or ornaments to speak of, the whole beauty being centered in the jets of water illuminated by electricity and shaded with different colored lights.

Wood's Arc Lamps.

The Fort Wayne Electric Company have recently put on the market a new form of arc lamp, the invention of Mr. J. J. Wood, which is rapidly coming into favor. Gen. Andrew Hickenlooper, president of the Cincinnati Gas Company, has just put in a plant using 100 of these lamps, and he speaks of them as among the most perfect arc lamps ever invented.

The lamps used in this system, and shown in the accompanying illustrations, are Mr. Wood's latest design, for which patents have just been issued. These lamps are ornamental in appearance, as well as perfectly automatic in operation. They are fitted with hand cut-out, automatic cut-out, automatic re-lighter and automatic short circuit, which removes them from the circuit as soon as the carbons are consumed, as well as allowing both single and double lamps to be operated in the same circuit with perfect safety. They are also fitted with an ash cup to facilitate cleaning, as well as to prevent

FIG. 1.—NEW DOUBLE CARBON WOOD LAMP.

the possibility of carbons dropping from the holders, through carelessness or otherwise. The frame work is constructed in such a manner as to be substantial as well as ornamental in appearance. It is also weather proof and perfectly insulated from the circuit. The binding posts are fitted with hooks to enable the lamp to be suspended from the hangerboard, in addition to the suspending ring on the frame. The carbons are fed by a small train of clock work controlled by an electro-magnet, which gives a uniform feed, and subsequently a steady white light, free from hissing. This is constructed to allow a rapid movement of the feed rack in either direction to facilitate trimming. When once adjusted, it is practically impossible for these lamps to get out of order without manual interference, and the claim is made that they can be handled with perfect safety in a circuit of 4,000 volts E. M. F.

When Shall We Say the Same?

Under the above heading, the London *Electrical Review* says: "There are now established in nearly every town and city central

FIG. 2.—NEW SINGLE CARBON WOOD LAMP.

stations for supplying arc and incandescent lighting. The managers of these central stations have found it to their advantage to operate a portion of their plants for the distribution of power by means of electric motors." There is scarcely any need for us to remark that these paragraphs refer not to England but to the States, and they are quoted from a beautifully compiled pamphlet on the Thomson-Houston motor. The day may come, but it advances but slowly, when English electrical firms can introduce their goods to the notice of the public in the same strain; in the meantime we can only congratulate our American cousins upon the vast expanse of country under their control which leads to the numberless great electrical enterprises of which we hear almost weekly, the electro-motor industry now bidding fair to rival that of electric lighting.

The Carbon Cure.

[N. Y. *Sun*.]

And now the burned-off carbon points,
By some strange mysticism,
Are carried round in pockets as
A cure for rheumatism.

The Fast Telegraph Tournament.

This interesting telegraphic event, which occurs April 10, 1890, at Hardman Hall, New York city, promises to be a very successful tournament, and is attracting more attention than any former contest in telegraph circles. Mr. Fred. Catlin, the manager, has been untiring in his efforts, and was surprised to find the interest that was taken in the tournament immediately on its announcement.

The entries were closed last week. Forty gentlemen have entered for the contest, and 15 ladies. Pittsburgh, Philadelphia, Richmond, Washington, Hartford and Providence, will be represented.

Many of the old-time telegraphers are taking an interest in the contest. Mr. Chandler, of the Postal, General Eckert, of the Western Union, and many others prominent in the telegraphic world expect to be present. Mr. Edison, on being asked to contribute by Mr. Catlin, who suggested that perhaps fame and prosperity had caused him to drift too far away from early telegraphic associations to be interested in this event, replied: "I hope I haven't changed a particle. I'd rather have the small-pox than a swelled head. Put me down for $25."

There will be two sessions of the tournament—afternoon and evening. The ladies will probably participate in the afternoon contest, and the gentlemen in the evening.

The following is the list of contestants:

CLASS "A."

New York.—	
John W. Roloson,	Postal Tel. Cable Company.
W. Davis,	" " " 187 Broadway.
James P. Bradt,	United Press.
W. M. Gibson,	" "
Frank J. Kihn,	" "
W. L. Waugh,	" "
Frank L. Catlin,	Henry Clews & Co.
George W. Simmonds,	Fifth Avenue Hotel.
M. H. Toomey,	Stock Ex.
H. Peters,	Postal Tel. Cable Company, 187 Broadway.
Hartford, Ct.—	
B. R. Pollock, Jr.,	N. Y. & N. E. Railroad.
Washington, D. C.—	
H. S. Wright,	United Press.
Philadelphia.—	
H. T. Paulhamus,	Postal Tel. Cable Company.
Andrew J. Swan,	Western Union Tel. Co.

OLD-TIMERS.

New York.—	
A. S. Ayres,	United Press.
John H. Dwight,	Western Union Tel. Co.
Fred. Catlin,	" " "
Annapolis, Md.—	
Charles H. Gogel,	Postal Tel. Cable Company.
Pittsburgh, Pa.—	
Geo. M. Eitemiller,	Western Union Tel. Co.

CLASS "B."

New York.—	
W. L. Waugh,	United Press.
James P. Bradt,	" "
J. G. McCloskey,	" "
E. A. Sprong,	" "
Frank L. Catlin,	Henry Clews & Co.
David Wark,	W. U., 195 Broadway.
C. G. Millard,	" "
M. H. Toomey,	Stock Exchange.
O. Hart,	Charles Head & Co.
Frank English,	" " " Mills Bldg.
W. Davis,	Postal, 187 Broadway.
M. J. Doran,	Johnson & Boardman.
W. A. Jones,	Nat. Transit Co., 26 B'way.
J. D. Hinnant,	" " "
F. F. Norton,	Postal, 187 Broadway.
W. D. Chandler,	Associated Press.
W. B. Upperman,	" "
Washington.—	
H. S. Wright,	United Press.
Richmond, Va.—	
C. W. White,	W. U. T. Co., 1300 E. Main.
Philadelphia.—	
H. T. Paulhamus,	Postal.
Andrew J. Swan,	W. U. T. Co.
Robert C. Mecredy,	" " Com. Exchg.
Providence, R. I.—	
A. S. Patterson,	Western Union Tel. Co.
Pittsburgh, Pa.—	
Ed. Bishop,	Western Union Tel. Co.

LADIES' CLASS.

New York.—	
Miss Belle M. Dennis,	1227 Broadway.
Miss E. R. Vanselow,	195 Broadway.
Miss Jennie Schlesinger,	195 Broadway.
Miss Tillie V. Freschel,	193 Broadway.
Miss Kittie B. Stephenson,	195 Broadway.
Miss Adele Erbelding,	195 Broadway.
Miss Millie Moss,	195 Broadway.
Miss Mamie Smith,	Caldwell & Bunker, Brokers, Wall street.
Miss M. A. Daley,	W. U., 457 E. 10th st.
Miss L. Wagner,	W. U., 8th ave. & 23d st.
Miss Annie M. Schaffer,	Postal, 187 Broadway.
Miss Emma V. Garthwaite,	195 Broadway.
Miss Minnie White,	W. U., 821 Sixth ave.
Miss S. C. Barry,	" " "
Miss Anna E. Findley,	Postal, 91 Wall street.
Mrs. M. E. Randolph,	195 Broadway.

RECEIVERS.

New York.—	
E. A. Sprong,	United Press.
John Turnan,	Postal, 187 Broadway.
A. J Lafaye,	W. U., 195 Broadway.

PRIZES OFFERED BY MR. WALTER P. PHILLIPS.

Mr. Walter P. Phillips, general manager of the United Press, writes Manager Catlin as follows:

"MY DEAR SIR: It having been decided by the judges in the forthcoming fast-sending tournament that the decisions shall be on the basis of the fastest time made, provided the sending is readable, I have concluded to offer four supplemental prizes to the amount of $100, and write to say that I will pay $25 to that contestant, in each class, who is adjudged to have done the most finished and accurate sending in the quickest time. I thoroughly understand that it has been your aim to lower the record, and that this is a fast telegraphing tournament, and not one in which the most musical or most finished sender is to carry off the honors, unless his time is also faster than that of others. But for these fast-sending trials, which have occurred at intervals since 1867, there would be no phenomenal senders in the business now, and the purpose they serve is therefore admirable. At the same time, the work of a Messonnier is as much entitled to recognition as that of his brother artist who paints on broader lines and on a more extended canvas, and I am persuaded that by putting a premium upon accuracy and rhythm in telegraphic manipulation, we may incidentally encourage the school of beautiful senders in a tournament for the benefit of that small class of gentlemen whose nerves of steel have enabled them to make time calling for an average of 19 movements of the hand per second—an achievement which places the piano gymnastics of Thalberg, De Meyer, Von Bulow, Rubenstein, Essipoff and D'Albert, decidedly in the shade.

Fraternally yours,
WALTER P. PHILLIPS.

More Electrical Apparatus for the Transvaal.

We gave a description some time ago of a large installation for the electric transmission of power, which was being manufactured by the Sprague Company for the Forbes Reef Gold Mining Company, of the Transvaal, South Africa. This plant will transmit power from a waterfall where are situated a number of Pelton wheels, to the mine premises, more than three miles away. The wires connecting the water wheel with the electric motors at the mine, will be carried upon poles right across country in a direct line. The amount of power transmitted will be 140 horse-power.

The Forbes Reef Company are now so thoroughly satisfied that electricity is the most convenient and economical agent for transmitting power long distances, and applying it at its point of use, that the managers of that company have ordered additional apparatus, including dynamos and motors, with wires for the transmission of 75 more horse-power. This will make a total of 215 horse-power, to be transmitted from the water-power, which will be used on the mine premises.

It is estimated that the efficiency of the whole electric system will be about 70 per cent., that is, out of every ten units of power delivered from the turbine to the dynamo, seven units will be delivered from the water pulleys for work, and only three lost in the transmission in both machines.

Part of this apparatus has already been shipped to the Transvaal, and the rest will follow soon. The construction and installation of this plant will be under the direction and supervision of Mr. Wm. Rydler, of the Sprague Company. When this is finished it will be one of the largest if not the largest and most extensive electric mining transmission plant in the world. While it is to be regretted that the managers of mines in this country have as yet not availed themselves to any very great extent of the advantages in the transmission of power by electricity, it will probably not be long before many of the water powers which now run to waste in many mining localities will be utilized with advantage.

—— The fifth annual report of the Board of Gas and Electric Light Commissioners, of Massachusetts, shows that there are in the State 75 gas companies, of which 26 have the right to supply both gas and electricity, and no fewer than 100 electric light and power companies. The number of public gas lamps continues to diminish in about the same ratio as last year, electric lights taking their places. The coal gas companies lost 999 lights. The year was an active one for those engaged in the electric lighting business. There were 44 new electric light and power companies incorporated.

Queen & Company's New Standard Megohm Box.

The rapid and widespread growth of the electric lighting industry and consequent multiplication of manufacturing companies, has necessitated the closest attention to the smallest details of installation, in order to secure contracts. The close interest displayed by the public has also compelled the adoption of all accessories tending to greater safety in operating plants and central stations. One of the greatest sources of peril is well known to be poor insulation, and high insulation is now almost the prime essential among makers of electric light wire; the most careful measurements being taken by them and used as evidences of the greater or less value of any particular brand.

NEW MEGOHM BOX.

In making reliable instruments of this kind one of the most valuable requisites is a first-class and accurate standard of high resistance. In response to the great demand for a standard of this kind, Messrs. Queen & Company, of Philadelphia, the well-known manufacturers of test instruments, have just completed a new form of megohm box, which we illustrate on this page. The box here shown has been especially designed so as to prevent all leakage while measurements are being made, and is claimed to be the finest ever designed in this respect. The coils are 40 in number, each of 25,000 ohms resistance, and are united in sets of four; the terminals of each set of four coils are mounted upon corrugated rubber pillars, very highly polished, an inch and a half high, the corrugations making the pillars equivalent in insulating surface to pillars three inches high. The rods passing from these outside terminals to the extremities of the coils within the box do not touch the rubber pillars except at the top, the pillars being cut away inside for that purpose so as to enclose the rods without contact. The binding posts or terminals may be so connected, by means of the metal straps, as to throw any number of the coils together in series or in multiple. The coils themselves are wound of platinoid wire and adjusted by Prof. Wm. A. Anthony to the highest degree of precision, while the mechanical finish throughout is of the very best.

Manufacturers of cables or high insulation wire and all others who require to measure very high resistances or to test and measure the insulation of wires and insulating compounds, will find this megohm box splendidly adapted to their needs.

A Chinese Light Company.

A San Francisco *Examiner* reporter had an interview recently with Wong Hong Tai, the resident Chinese Edison, whose electrical genius formed the subject of an article some months ago.

Electric lights, Tai has discovered, promised to be the only thing in this line that were likely to meet with patronage from his countrymen. They would buy light because they could see what they were getting, even though they did not understand the principle of production.

So Wong Hong Tai went into the study of electric light. Connected with all the lights was a regulating key of Tai's own invention, by means of which the light can be lowered or raised with the same steadiness and to as great a degree as the flame of a lamp.

"That is not really necessary," said Tai, "but I do it to please the Chinese. They do not want to waste anything—not even a ray from an electric light."

Tai worked on for a month or two and then showed his model plant to some of his wealthy countrymen. The capitalists with pigtails comprehended at once. Within a week the Canton Electric Light Company was organized with a capital of $400,000, ready to be paid up at a moment's notice. Communication was opened with Chinese capitalists in Canton, as much more capital was subscribed there, and a permit obtained for the introduction of electric light into the largest commercial city of China. Wong Yin, of San Francisco, was elected president, and Wong Hong Tai, general superintendent and manager. Tai purchased a $1,400 plant for illustrative purposes, and is now packing up to go to Canton to begin active operations, leaving behind him orders for nearly $100,000 worth of dynamos and other apparatus, to be filled on the instalment plan as business warrants.

"This move is creating a big excitement at home," said Tai, yesterday. "Wong Yin and my son have been in Canton for some weeks, illustrating the company's business with a small dynamo. My people are beginning to wake up. Kwong Suey is only 22 years old, and yet he has been in the Emperor's chair for 14 years. His mother has given him a different education from that ever accorded any other Chinese ruler. She could do nothing herself, but the moment Kwong Suey attained years of discretion, her influence began to be felt through his enlightened policy. It is only five years since the telegraph was introduced to China proper; the telephone and gas are still strangers. It is a big jump from oil to electricity in Canton, and I do not wonder at the excitement that the move is creating. We have no fears of a failure, however. The first piece of railroad in China was built about the same time as the telegraph. Stock was issued for $100 per share. That same stock cannot now be bought for $800 a share.

"Kwong Suey and his government will encourage improvements of all sorts, but his policy is to push them with Chinese capital. The rich silver mines of Shantong have long been looked upon with covetous eyes by foreign capitalists, but have been allowed to lie unworked for centuries. Now they are being opened up, and a number of intelligent Chinese are scattered over the world, studying the various systems of mining and working ore. I think I shall soon be proud of my people."

Relation of Heat to Resistance.

We are indebted to Professor Robert Spice, of Brooklyn, for the following instructive experiment to prove that the heat generated in an electrical conductor varies directly as the resistance.

The apparatus consists of two small metallic vessels, one double the capacity of the other; two coils of wire, one of resistance R, and the other of resistance $2R$. The two vessels are placed in contact with the opposite faces of a thermopile, which is connected up with a galvanometer. The current passes through both coils of wire

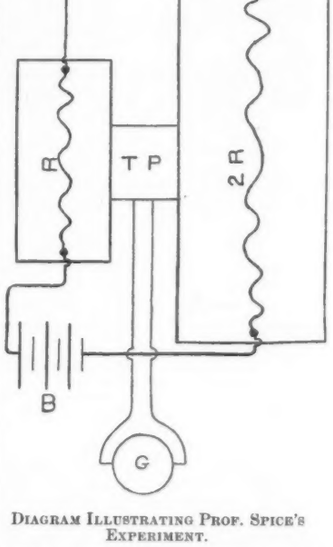


DIAGRAM ILLUSTRATING PROF. SPICE'S EXPERIMENT.

in series; therefore there is the same current flowing in each coil. If there should be a difference in temperature between the metallic vessels, the thermopile would deflect the galvanometer needle; if there is no difference, the needle would remain at zero.

Finally, the vessel of capacity 1, containing resistance R, is filled with kerosene; the vessel of capacity 2, containing resistance $2R$, is also filled with kerosene. Consequently, as $2R$ gives twice the heat of $1R$, and is immersed in twice the quantity of liquid, the temperature of both vessels will rise alike, and the galvanometer needle will remain at rest. On account of the delicacy of the thermopile, the experiment need only last a few seconds, thus avoiding the usual loss by radiation, etc. A reference to the diagram will make the experiment plain.

Professor Spice used this method (of unequal weights of bodies) to determine specific heat problems, as many as five years ago, although he has never published the idea.

Gas and Electricity.

At a recent meeting of the Ohio Gas Light Association, Mr. Allen R. Foote read a very interesting and valuable paper on "Municipal Control of Gas and Electric Lighting Plants." After opening his address with some remarks upon economic evolution, Mr. Foote proceeded as follows:

"The advocates of municipal control of lighting give but one reason for their policy It is that it will make the lighting service cheaper. The same argument will serve equally well a movement for municipal ownership of:

"Gas plants,
"Electrical plants,
"Street car lines,
"Ferries and
"Telephone exchanges.

"More than this, it will suit just as well, a demand for the national ownership of:

"Railroads,
"Telegraphs and the
"Express business.

"But why stop here? It will apply with still greater force to the national ownership of every productive or distributive industry.

"The results of municipal ownership may be proven now. There are a sufficient number of undertakings of that character now in operation to render the demonstration complete. If the claims of those who advocate municipal ownership be true, they can prove them by accounts now being kept. I challenge any municipality in the United States owning a gas or an electric light plant, to submit the question of the policy of municipal ownership to the arbitration of provable facts. That this may be done, attention must first be given to the classification of items and the forms of accounts of receipts and disbursements. The greatest difficulty in the management of their private affairs. If men are not exact and honest with themselves in the management of their own finances, how can they be made exact and honest in the management of municipal finances? The only safeguard for the man and for the municipality, is the regular publication of accounts in approved forms, showing every dollar of income and expense, in items classified in accord with the requirements of a sound economy. The question of honesty is of minor importance in the demand for a scientific system of economic accounting. A system of accounting that will satisfy economic requirements, will satisfy all moral requirements. Money may be spent honestly and not be spent economically. There can be no scientific demonstration of economic results, without a scientific record of economic operations. Upon such data only can economic policies be safely based. Those favoring municipal ownership can afford to wait until such data can be obtained, before committing their municipality to a measure of doubtful expediency, and one that may ultimately prove undesirable.

"I say to the people of all municipalities that have committed themselves to the principle of municipal ownership, you have entered upon an economic policy that will ultimate in industrial slavery. You sought escape from a limited monopoly, and have established an absolute monopoly. You are levying a tax on consumption, instead of possessions. This is the most inequitable form of taxation.

"When the municipality owns the plant, the wage earner and the millionaire pay exactly the same rate for the gas they consume. The profit on that gas compels the wage earner to pay a tax a thousand times greater in proportion to his income, than the tax that is paid by the millionaire.

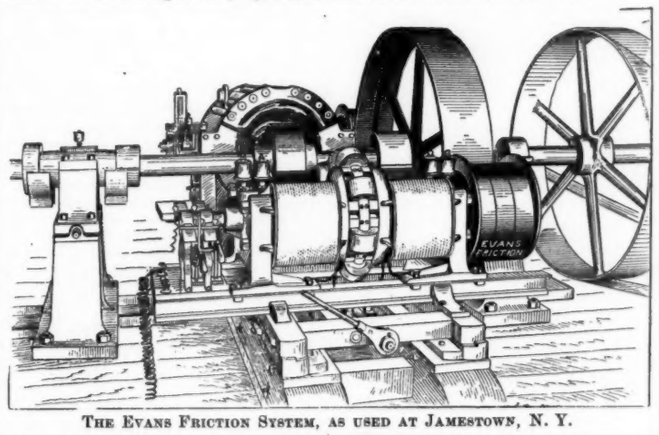
"The policy of municipal ownership of lighting plants can be successfully combated upon practical lines. Let the whole truth be known regarding the accounts of such plants, let the people become thoroughly educated as to the workings and tendency of such undertakings, and, speaking of one of them as representing the whole, the sale of the Philadelphia gas plant to private ownership and management will become a political necessity."

Transfer of Electric Light Property.

The property of the Weston Electric Light Company, which has been operated by the United States Electric Light Company, in Newark, since 1881, was formally transferred to the United States Electric Light Company last week, and a mortgage for $750,000 was recorded as given to Marcellus Hartley, of this city, who, with H. B. Hyde and Anson Phelps Stokes, has controlled the stock for years and is one of the vice-presidents of the company. A little more than a year ago the Westinghouse Electric Company took the works on a contract with the United States Electric Light Company.

The Evans Friction System at Jamestown, N. Y.

Our illustration on this page represents an application of the Evans Friction System, at Jamestown, N. Y. As will be seen, the fly wheel is connected by the friction belts with two dynamos, one placed on either side of the shaft. The great advantage derived is in being able to throw any one machine in or out of gear, without interference with the other dynamos running from the same shaft. Mr. Charles W. Grant, president of the Jamestown Electric Light Company, is loud in his praises of this system of driving dynamos, and says that if his company ever builds another station, they will use no other method of running their machines.



THE EVANS FRICTION SYSTEM, AS USED AT JAMESTOWN, N. Y.

The "Helmet Brand" Wire.

The Empire City Electric Company has just placed a new insulated wire upon the market under the name of the "Helmet Brand." The company is manufacturing this wire in various grades of insulation, and of all sizes, to meet the constantly increasing demand for cheaper wires of good insulative qualities. It is meeting with much favor in the trade, and is selling rapidly.

The new wire catalogue of this company is a very neat and attractive one, the cover being beautifully shaded and of unique design.

Denison, Tex.—Belton Electric Light Company; capital $200,000; incorporators, D. A. Chamberlain, M. V. Smith and Ida Bryan.

Albany, N. Y.—A certificate of incorporation of the Home Electric Light Company, of Ilion, was filed last week in the office of the Secretary of State; capital $15,000.

Chicago, Ill.—The Chicago Incandescent Lamp Company, at Chicago; capital stock, $1,000; to manufacture electrical supplies; incorporators, F. B. Caldwell, Frank J. Reed and A. Oppermann.

Annapolis, Md.—The Woodberry & Belt Electric Light and Power Company, for the city of Baltimore and Baltimore County, has been incorporated by James E. Hooper, Francis E. Waters, W. Irving Walker, George Poole and Henry Hutton, all of the city of Baltimore, Md. Its object is to supply electricity for illuminating purposes and all other purposes to which electricity may be applied. The capital stock is $100,000, with privilege of increasing it to $1,000,000.

Carthage, Mo.—To the Carthage Light and Fuel Company, of Carthage; capital stock, $100,000, all paid up. Incorporated by H. C. Messenger, of Carthage; C. H. and H. A. Martin and George B. Campbell, of Fort Scott, Kan.

Jefferson City, Mo.—The Secretary of State issued certificates of incorporation to the Cross-town Electric Railway Company, of St. Louis; capital stock, $100,000, half paid up. Incorporated by G. Campbell, E. D. Meier, D. K. Ferguson, D. W. Brown, P. K. Marion and C. C. Carroll.

Albany, N. Y.—The Asphaltum Pipe and Subway Company; to mine, manufacture, distribute water and construct subways for electric conductors. Capital stock, $400,000, all of which has been subscribed. Directors, F. M. Speed, Edgar Briggs, Adrian R. Smith, George H. Hops and W. H. Warswick.

Aiken, S. C.—The Aiken Water and Light Company; principal place of business at Aiken; object, to furnish water, light or drainage, to the citizens of the city of Aiken and vicinity; capital, $5,000, in shares of $10 each. Incorporators, P. A. Emanuel, Wm. Turnbull, Geo. W. Croft, Henry Hahn and John F. Gaston, all of Aiken.

Harrisburg, Pa.—The Ashbourne and Cheltenham Electric Light, Heat and Power Company, of Montgomery County; capital, $10,000.

Carrollton, Mo.—The Carrollton Water Company filed affidavit of extension of business and change of name to Carrollton Light, Heat and Power Company.

Toronto, Ont.—The Kakabeka Falls Land and Electric Light Company, Limited; capital stock, $800,000, in $100 shares. The promoters are A. P. Boller, New York; E. D. Smith, Alexander McGan, E. V. Douglas, Philadelphia; W. P. Douglas, Minneapolis.

San Francisco, Cal.—Electric Street and Station Indicator Company, of San Francisco. Capital stock, $500,000. Amount actually subscribed, $420,000. Directors, John L. Cahill, Lucius H. Foote, Alex. G. Hawes, Joseph D. Grant and Rueben H. Lloyd.

Minneapolis, Minn.—The Carpenter & Nevins Electro-Heating Company have filed articles of incorporation, with a capital stock of $300,000. The incorporators are M. S. Scofield, J. W. Kelly, L. Kimball, Robert C. Long, S. W. Nevins and Charles E. Carpenter.

Rochester, N. Y.—The Consolidated Gas and Electric Company, of Batavia, has been incorporated with a capital stock of $100,000. The concern will absorb the stock of the Consumers' Electric Light and Power Company and the Batavia Gas Light Company.

Albany, N. Y.—With a capital of $5,000, the Fisher's Island Telephone Company has been incorporated at Albany, to construct a line of telegraph on Fisher's Island, Suffolk County, or from or to any other points within this State. The entire number of shares but three are taken by E. M. Ferguson, Pittsburgh, Penn., and Walter Ferguson, of Stamford, Conn.

Columbus, O.—Citizens' Gas and Electric Company, Cleveland; capital stock, $250,000.

Des Moines, Ia.—Citizens' Electric Light and Power Company, Muscatine; capital stock, $25,000.

Albany, N. Y.—The Bolet Electrical Manufacturing Company, of Brooklyn, has been incorporated, with a capital of $300,000.

Camden, N. J.—Articles of incorporation were filed yesterday in the county clerk's office by the Keystone Electric Battery Company.

Woonsocket, R. I.—The River Point Electric Light Company has decided to organize, with a capital of $30,000. It will use the Edison system.

Wichita, Kan.—The Wichita Electric Railway Company, of Wichita. Directors: J. O. Davidson, Thos. G. Fitch, Geo. L. Rome, B. H. Campbell, C. A. Walker. Capital stock, $1,000,000.

Chicago, Ill.—California Railway Company, at Chicago; to construct and operate street railroads; capital stock, $500,000; incorporators, Edward Russell, W. M. McEwan and F. H. Russell.

Sandy Hill, N. Y.—A certificate was filed in the office of the Secretary of State showing that the capital of the Sandy Hill Electric Light and Power Company has been increased from $15,000 to $25,500.

Indianapolis, Ind.—Electric motors, sewing machines, etc., will be manufactured by the Pullman Electric Motor Company, of Logansport. This concern, with a capital stock of $25,000, is incorporated under State laws.

Covington, Ky.—The Falmouth Electric Light and Motive Power Company; capital stock $50,000, with John C. Hamilton, John King, J. W. Thompson, Wm. Applegate, D. L. Frazier, Theo. Bradford and J. N. Riggle, as incorporators.

Harrisburg, Pa.—A charter has been granted to the Sun Illuminating Company, of Pittsburgh; capital, $5,000. The directors are, J. B. Griggs, of Allegheny; W. M. Cooper, of McKeesport; James M. King, of Edgewood, and H. L. Trus and J. H. Young, of Pittsburgh.

Batavia, N. Y.—The Consolidated Gas and Electric Company, of Batavia, was incorporated last week, with a capital stock of $100,000, divided into $6,000 shares. The incorporators are S. D. Purdy, Henry Croft, Charles H. Caldwell, Richard C. Garhart and Russell L. Kinsey.

Cleveland, O.—The Citizens' Gas and Electric Company has filed articles of incorporation in the office of the Secretary of State, at Columbus: The capital stock of the company is $250,000. The incorporators are: Jeptha H. Wade, Jr., W. J. Rainey, Samuel P. Ely, Mars E. Wager and Cyrus P. Leland.

Washington, D. C.—The Columbia Electric Company. The incorporators are: John W. Thompson, Lewis Cephane, Fred. W. Royce, Green B. Raum, Thomas J. Luttrell, Charles C. Lancaster, T. E. Roessle, all of the District of Columbia; Caleb H. Jackson, E. T. Platt, Paul D. Cravath, of New York; James S. Humbird, P. Foley, Gilbert T. Rafferty, James Atwell and George T. Oliver, of Pittsburgh. The object of the company is to supply electricity for lighting, telephoning, motive power or other purposes, to persons or corporations in the District of Columbia. The capital stock of the corporation is to be $250,000, which may be increased by the stockholders to $5,000,000.

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The metropolitan dailies contain regular reference to a great electric light consolidation or "trust." The figures are put at $50,000,000, with a 10 per cent. profit. Who wouldn't be an electric light man?

The Electric Clubs of this country have become a prominent feature of the electrical history of the day. The REVIEW, on another page, presents a new department which we think will be popular and entertaining, presenting each week, or as often as desirable, a review of the incidents, hints and gossip, that find their source in these organizations where the gatherings are not only congenial and pleasant, but instructive and valuable as well.

The severe storms of last week played sad havoc with the telephone and telegraph wires in all parts of the country through which the tornado passed. The Western Union, naturally, suffered the most severe losses, but with commendable promptness, communication was established with stricken Louisville, and anxious relatives and friends were able to hear from those who were in the city at the time. The wires have nearly all been replaced, and things are beginning to work smoothly once more.

A popular belief which has become a proverb, that "lightning never strikes twice in the same place," has once more been proved fallacious. The tallest smoke stack in this country was struck twice within a half-hour during last Friday's storm. The reason this saying has become a common text with a great many people, from which a sermon may be preached upon occasion, is undoubtedly because after a lightning bolt has once visited any high point there is seldom enough of the remains left for a second bolt to have any fun with.

Mr. W. H. Snell, the able young editor of *The Electrician*, London, died in that city, recently. Mr. Snell was a highly esteemed member of the editorial profession, and all the electrical press unite in honoring his name. The writer of this was under obligations to Mr. Snell for kindnesses shown him during a recent visit, and feels with others that the technical press has lost an able and promising member.

The telegraph tournament, to be held next week, will be an interesting event, and is now the chief topic in telegraphic circles on this continent. The letter from Mr. Paillips, published on another page, in which he says the nerves of steel of some operators have enabled them to make 19 movements of the hand per second, and compares this work with that of the great pianists, is sure to attract attention and makes one think of the operator's skill in a new light.

We publish in another column the annual report of the American Bell Telephone Company, for 1889. The showing made is exceptionally good. The net earnings for the year were equal to about 26¾ per cent. on the old capital, and above 21 per cent. upon the enlarged capital. Of the new capital, $1,250,000 shared in the dividend of January 15, 1890, and was made a charge against 1889 earnings. The remaining half will participate in the July dividend.

At no time in the history of the REVIEW has its list of subscribers been extending more rapidly, or the demand for advertising space more urgent and persuasive. To be appreciated in this way by the brainy, progressive and thoroughly wide awake men who compose our electrical constituency, is a source of sincere gratification, aside from all consideration of commercial success. Every person identified with electrical science and electrical industry has reason to be proud of his calling, for to be engaged in this progressive and important and difficult field stamps the worker as a man of intelligence and force.

Central station electric lighting is going ahead at a great rate in Berlin. The following figures, which are beyond question authentic, show a very remarkable development during the past two years. In 1888 the amount of horse-power expended for electric lighting purposes was only 3,950. In 1889 this had increased to 8,650, and it is estimated that in the present year, when work now in hand is completed, and the various installations provided for are all in going order, there will be a total expenditure of 18,300 horse-power for electric lighting alone. We congratulate the inhabitants of Berlin on their enlightenment.

A town meeting has been called by the authorities of Rutland, Vt., for the purpose of acting on a proposal to sell an electric lighting plant to that municipality. An electric lighting company has been performing this service for the town for some years. The service has always been good, they are willing to do the business at a reasonable price, and their plant is so well installed and superintended, that they have operated it without casuality to life or property. The proposed action on the part of the municipality virtually means the destruction of the private capital that has been invested and so well managed in this service.

We note that the subway question promises to be productive of as much trouble in London as it has been in this unfortunate and misgoverned city. No fewer than 36 petitioners have deposited petitions in the private bill office of the House of Commons, praying to be heard in opposition to the bill promoted by the London County Council for constructing subways for pipes and wires under the streets of the metropolis, and for the creation of an efficient system of control over aerial wires and cables. This number of petitions is larger than any number that has yet been deposited against any English bill now before Parliament, but it does not fully represent the strength of the opposition to the bill, as many companies have consolidated their petitions. Among the opponents are 13 railway companies, 10 local and other governing authorities, five gas companies and six telephone and hydraulic companies, besides electric light corporations without number. Apparently, the subways are going to have a hard time of it in London.

A REVOLUTION AT THE WRONG END.

We notice that a project is on foot to revolutionize the construction of cars used on steam roads. A corporation known as the Steel Tubular Car Works, has been formed with a capital stock fixed at $5,000,000, to construct cars having a frame work of steel tubing so arranged as to withstand the severest shocks of collision or derailment; the cars are to be secured against telescoping by means of a series of rigid longitudinal tubes, and injury from derailment or overturning, by a series of tubular hoops, forming a portion of the frame work. The steel frame work will be fitted with panels, floor and roof of incombustible material, so that the new car will be impervious to the action of the overturned stove when an accident does take place, thus robbing railway tragedies of one of their chief horrors—in fact, a practically indestructible car is promised.

New projects generally aim to "revolutionize" something. The chief fault we have to find with this one is that the revolution is to take place in the wrong direction. Certainly there is much room for improvement in the construction of railroad cars. What are known as the "day coaches" are of far lighter construction than the sleeping and drawing room cars, as a recent accident on the Grand Central line demonstrated very clearly, and more solidly built "day coaches" would be hailed by all travelers with satisfaction for the slight additional sense of security they would experience when traveling in them.

But it is not by the introduction of ironclad incombustible cars that the railroad companies should seek to add to the safety of railway travel. They should, as we have frequently urged, attend better to the equipment of their lines with electric signaling apparatus, adopt the block system so successfully used on the Pennsylvania system, and maintain their telegraph departments in a better state of efficiency than they do at present. Electricity, intelligently applied and directed, can do, and abroad is made to do, very much more than indestructible and incombustible cars ever will, to make travel by steam as safe as human skill can make it. Let our railroad magnates, rather than seek to make cars impervious to the effects of trains coming together, look to keeping them apart. Electricity will help them to do it.

CAPITALISTS, ATTENTION!

This time he lives in Ohio; he sent a letter the other day to a gentleman connected with one of the large electrical manufacturing companies in this city, offering his inventions in the usual confidential way. Here are two of his modest claims: "One of my inventions consists of a dynamo complete capable of lighting one hundred 16 candle-power incandescent lamps per horse-power, or even a greater number." This dynamo will also "light and heat 1,000 rooms on a 100-mile circuit with an expenditure of 10 horse-power." His sole object in writing was that he wanted "you folks to take some shares in this corporation." The orthography and literary style of the letter warrant us in stating that the writer is an inventive genius of the first water. We hate to give this "snap" away, but we always print the news, and if this isn't news, we'll murder the office cat.

The London *Electrician*, in its issue of March 7, publishes an interesting article on "Seeing by Electricity." The writer makes a comparison between the ear and the eye, pointing out the comparative simplicity of the former organ, and the certainty with which its functions can be performed by electric apparatus and an electric wire. The eye, however, is an infinitely more complex affair, with its combination of lenses and millions of tiny-like, sensitive structures, and the reproduction, at a distance, by electricity, of the complex conditions which form the most delicate of the five senses of man is looked upon as an utter impossibility as far as our present knowledge of electricity goes. The article concludes with the following discouraging remarks: "There is more hope of seeing through the proverbial brick wall than of seeing through a copper wire." Such a conclusion may seem very unsatisfactory, it may damp many eager hopes; nevertheless, there is no other conclusion possible in the present state of electrical science.

CORRESPONDENCE.

Electrical Happenings in Washington, Albany, Boston, Chicago, St. Louis.

OUR WASHINGTON LETTER.

The Continental Dynamo Company, of New York, is making its first installation in Washington, in the factory of the Hygenic Ice Company. One hundred 16 candle-power lamps will be operated by the initial plant, which will be enlarged to meet future necessities.

Mr. Geo. S. Patterson, who has been for several years connected with Thomson-Houston roads in the vicinity of Boston, has gone to Washington to take charge of the electrical department of the Eckington road. The large extensions already made and contemplated, and the extraordinary increase in the traffic of the Eckington Company, have rendered the establishment of several divisions in its management absolutely necessary.

Mr. J. W. Crawford, who is the only civilian electrician in the Naval Bureau of Electric Lighting, has resigned his position, and on the 1st of April will enter the service of the Field Engineering Company, in New York.

An influential delegation, representing the Sprague electric motor interests, appeared before the Naval Committee of the House of Representatives, last week, to urge the passage of the pending bill appropriating $250,000 to pay the cost of making experiments with the Sprague system of motors, to determine their adaptibility to various purposes on ship-board, for which steam and pneumatic power are now used. The delegation consisted of Chief Engineer Robert B. Hine, U. S. N.; Lieut. Bradley A. Fiske, U. S. N.; Frank J. Sprague, S. Dana Greene, Uriah H. Painter and ex-Congressman J. S. Wise, of Virginia. The plan of carrying out the proposed investigation meets the approval of the committee and prominent naval officers, but it is the general opinion that such an undertaking should embrace an examination and test of all the different varieties of motors which may be offered to the government.

The Postal Committee received a letter from Dr. Green and General Eckert, president and vice-president of the Western Union Telegraph Company, inviting the committee to visit its offices in New York and examine the general operations of the company's system, and particularly to inspect the multiplex and automatic instruments in daily use. They say: "We court the most thorough investigation, and are willing you should employ experts to go through our books, accounts and statements. Since your committee have set about a patient and thorough investigation of the telegraph business, we respectfully suggest the propriety of completing the work from the best sources of information to be reached."

Washington, D. C., March 29. G. C. M.

OUR CHICAGO LETTER.

The Thomson-Houston Company report the following sales for the past week: B. F. Draper, Ligonier, Ind., 20-light arc machine —increase. The Shreveport Gas and Electric Company, Shreveport, La., 50 arc lights. Badger Electric Company, Racine, Wis., 30 arc lights—increase. Swanton & Clark, Santa Cruz., Cal., 650-light alternating machine. Mt. Clements Electric Company, Mt. Clements, Mich., 30 arc lights—increase.

English, Morse & Company, of Kansas City, Mo., are steadily increasing their business in the South and West, and report the following sales for the past ten days: Manitou Electric Light Company, Manitou, Colo., 90 horse-power steel tubular boilers. Exchange Building, Kansas City, 40 horse-power Ideal engine, for furnishing power to Edison dynamo used in lighting the building. Long Brothers' grocery house, Kansas City, 70 horse-power Ide engine. Kansas City Packing and Chase Regriferator Company, 300 horse-power Heine safety boiler. Antlers' Hotel, Colorado Springs, Colo., 90 horse-power steel boiler. Thirty horse-power Atlas engine to Fort Scott R. R. Company. Wire Dredge Manufacturing Company, Galveston, Tex., 45 horse-power Atlas engine. In connection with the above, this company report large sales of Jewell belting, American leather link belting, and patent rocking grates, for use in a large number of electric light plants in course of construction.

At Kansas City.—The exchange building will install an Edison dynamo for lighting the new building, and Long Brothers' wholesale grocery house will put in an arc and incandescent plant.

Personal.—Mr. George S. Hegeman, of the Edison Electric Light Company, of Kansas City, was a recent visitor at the Chicago office of the REVIEW.—Lafayette Cole, manager of the Peoria Electric Light and Power Company, will resign his position April 1, and thereafter represent Holmes, Booth & Haydens, through the West. Mr. Cole has the best wishes of his many friends in his new enterprise.

The Central Electric Company have recently added a full stock of the latest designs of electroliers. The above company are placing the Davis hand-book on the market. This little volume contains 130 pages of tables, etc., giving many valuable points to the practical man about an electric light station, and is of convenient size to slip into the pocket so as to be easily had when wanted. It will be no longer necessary to have an old note book pasted full of miscellaneous information clipped from catalogues and old school books, as this volume gives rules of every kind of electrical work, from digging a post hole to winding an armature.

The present capacity of the new Troop street electric light station, lately finished and started on March 17, is 700 horse-power in engines and 500 horse-power boiler capacity.

The terrible storm that visited Louisville on Thursday night seemed to have extended over a vast territory and was felt to a considerable extent in Chicago. Some little damage was done to telegraph, telephone and electric light wires in the suburbs, but owing to the complete system of underground wiring, no trouble was experienced in the city proper.

On Monday night the City Council will settle the question regarding the appropriation for extending the city's facilities for electric lighting. D. B. D.

March 29, 1890.

OUR ST. LOUIS LETTER.

A bill has been introduced in the House of Delegates, granting G. L. Babcock, C. Marquard Forster, John Herman and John M. Sellers, a franchise to erect towers in various parts of the city, to carry electric light, telephone, telegraph, etc., wires. It is to be known as the St. Louis Electric Tower Company.

The North and South Rapid Transit Company is a late corporation. It will be operated on Nineteenth street, and though it has not agreed upon any one motive power, it will, in all probability, use electricity. Its bill is now before the council. The Forest Park Railway Company will put the overhead system on its line, as soon as the weather will permit. The Market street and Laclede avenue railway lines have a bill before the council, granting them the right of using electricity. They will give the storage battery system a trial, as Wharton, of Philadelphia, claims to have perfected it, but will probably adopt the overhead system.

J. H. Vail, chief engineer of the Sprague Electric Railway and Motor Company, of New York, was here completing a contract with the Lindell Railway Company for 160 motors. This railway company will erect a power plant on Compton avenue, near Chouteau avenue. It will have 1,600 horse-power or 150,000 watts, from eight Edison generators. It expects to be in full running order within four months.

The Short people are putting new generators into the power house of the Seventh street branch of the Broadway line. Mr. Robert McCullough, general manager of the road, said that if the bill was passed allowing the Broadway line a double track on its whole length of road on that street, they would operate the Seventh street branch by the Short system, otherwise they would cable it.

The St. Louis Car Company has now in course of building, 30 electric motor cars for the Union Depot Line, of St. Louis.

St. Louis, Mo., March 22. W. H. B.

OUR ALBANY LETTER.

The Case of the Hudson River Telephone Company *vs.* the Watervliet Turnpike and Railroad Company, has been adjourned till April 15, on account of the engagements of counsel.

Senator Chase has introduced a bill providing that the taxable inhabitants of West Troy shall select five commissioners to act as a board of electrical control, to hold office five years. This board shall take entire control of the West Troy electric light plant and the lighting of the streets.

Assemblyman Curtis made an elaborate speech on his bill for the abolition of the death penalty, but action on the bill was finally deferred.

Several of the Papers of the State had insinuated that Assemblyman Curtis' opposition to the infliction of capital punishment was but a continuation of the fight against electrical execution recently carried on in the courts; and that it was instigated by the same corporations that had been opposed to the law. Accordingly, in the Assembly, March 28, Mr. Curtis rose to a question of privilege. The New York city and other papers had commented upon his course in regard to urging the abolition of the death penalty by affirming that it was a curious coincidence that his speech for doing away with capital punishment should follow so closely upon the heels of the decision of the court of appeals that the law for electrical executions was constitutional. He would make no lengthy explanation, but would simply state that the suggestion of any influence back of the matter was utterly without foundation. The bill was not drawn at the instance of any corporation, and it was not pushed at the instance or with the help of any corporation.

Albany, March 29, 1890. H. L.

OUR BOSTON LETTER.

Motors for Drawbridges.—Arrangements have been concluded by which the Thomson-Houston Motor Company has secured control of valuable patents pertaining to drawbridges operated by electric motors.

The New Arc System of the Westinghouse Electric Company was exhibited to a large number of invited guests on Wednesday evening, March 26, at the station of the Suburban Electric Light Company, Roxbury, Mass.

Mr. Geo. H. Morrison, one of the best qualified of Boston engineers, devotes most of his time to practical test work at electric light stations and power plants. His address is No. 6 Federal street.

The Daft Double Trolley System will be used on the street railways between the towns of Athol and Orange, Mass. The power station is at Athol.

The Westinghouse Electric Company has recently sold its new pattern arc light machine to the New Bedford, Mass., Gas Light Company and Brookline, Mass., Gas Company.

Mr. J. M Orford, of the New England Electrical Supply Company, Bridgeport, Conn., and manager of the Bridgeport Electric Light Company, was in this city last Thursday.

Mr. Harry G. Clay, Jr., of Philadelphia, the Pennsylvania agent of the Thomson-Houston Motor Company, paid a flying business visit to this city on last Tuesday.

Mr. Chas. S. Pease, of the Westinghouse Electric Company, spent a few days in Boston during the past week, on important business for his company.

Messrs. E. H. Johnson, W. A. Willard, W. J. Jenks and Edward Greenfield, of the Interior Electrical Conduit Company, of New York, were in this city on last Tuesday and Wednesday.

Jacobs' Feed-Water Heater, manufactured in this city, at No. 55 Oliver street, is attracting attention and favorable comment from electric light people, from the fact that it is a simple, effective and nicely constructed apparatus, built on mechanical and scientific principles combined.

Electric Railway Equipment—including six motor cars—for a two mile branch of the Bremen Tramway Company, Bremen, Germany, has been shipped this week by the Thomson-Houston Motor Company.

The Telephone Exchange, of Newton, Mass., will be removed from Newtonville to West Newton, and a new switch will be added to supply the demand for telephones in that district. The change will be made about May 1. This improvement will give both Newton and Waltham, Mass., the much needed proper telephone service.

Messrs. Frank Ridlon & Company, of this city, make a specialty of dealing in second hand apparatus for electric light central stations, isolated plants and electric railways. This firm has just sold several new Brush arc machines, and three Baxter electric motors.

Mr. Frank W. Harrington, as stated in the ELECTRICAL REVIEW, last week, has tendered his resignation of the position he has so long and faithfully held with the Western Electric Company, to take effect April 1. Mr. Harrington will take charge of the New York office of the Tropical American Telephone Company, and will be ably assisted by Mr. Henry W. Bates, who has been superintending matters for the company in that city since June, 1889. Prosperity and good health to Mr. Harrington in his new field of labor.

Electric Stocks.—Boston quotations at closing hour of the Exchange, Saturday, March 29, were as follows:

Thomson-Houston Electric Company	59.
" " " " Preferred	26.
" " " " Series C	17.
" " " " Series D	8.
Thomson Electric Welding Co	220.
" European Welding Co	115.
Westinghouse Electric Co	46.
Fort Wayne Electric Co	15.
Edison Phonograph Doll Co	6¼.
TELEPHONE:	
American Bell	222.
Erie	39¾.
New England	59¾.
Mexican	.77½
Tropical American	.50
National Tel Mfg. Co. (acoustic)	.65
Mass. Pulsion Tel. Co. (acoustic)	2¼.

Boston, March 29. W. I. B.

Mr. Frederic Bathurst, of England, favored the REVIEW with a call last week. Mr. Bathurst has recently arrived in this country, and is visiting us with the intention of presenting some of his electrical inventions for the consideration of American electricians.

Mr. W. A. Gibson, the well-known electric and gas fixture manufacturer, of Philadelphia, the one who has consistently refused to enter the "gas fixture trust," was a New York visitor last week. Mr. Gibson has the satisfaction of seeing his factory crowded with work as a result of his independent stand.

Subway Decision Reversed.

THE SUPREME COURT RENEWS THE INJUNCTION AGAINST THE BOARD OF ELECTRICAL CONTROL.

The General Term on Friday last reversed Judge Andrews' decision refusing an injunction restraining the Board of Electrical Control from executing the new subway contract with the Standard Electrical Company. The plaintiff in the suit was George E. Armstrong, a taxpayer. The General Term will issue an injunction when the order is settled.

As to the suit by the Manhattan Electric Light Company, which was also covered by Judge Andrews' decision, the General Term affirms the judgment, because, as they say, the plaintiff "has no such rights secured to it, either by the statutes or the agreement which it has made, as entitles it to interfere with the action of the Board of Electrical Control for the construction of the remaining subways, and no injunction at its suit is required by the circumstances."

The first action is brought by a taxpayer, and recites that its purpose is to enjoin the execution of a contract between the Board of Electrical Control and the Standard Electrical Subway Company. The law gives any person whose assessment for payment of taxes exceeds $1,000 the right to bring such action.

Reference is made to the legislation establishing the board for the purpose of providing a means for placing the electric and telegraphic wires in subways. The contract with the Consolidated Telegraph and Electrical Subway Company is referred to, as is also the fact that the company proceeded to build subways under it. It is also said that the subways have not been completed, and that the company has announced that, in its opinion, the subways cannot be completed in less than two years.

"It has not refused," says the court, "to proceed with the work, but, in consequence of an arrangement or understanding entered into with the Standard Electrical Subway Company, it proposes to surrender and assign all its rights and interests in certain portions of these contracts and the work it has already performed, to the latter company, and to carry this arrangement into effect a contract has been proposed by the Standard and sanctioned by the counsel for the city of New York, and whether this contract in this manner accepted is one which the acts already mentioned will allow to be executed and carried into effect, is the more important part of the controversy now before the court.

"No language has been employed in this part of the contract, or indeed in any other," continues the court, "by which this company agreed that it would build such subways as the board should direct it to build. * * * The board then reserve to themselves the right to permit any other company or corporation to build the subways not previously ordered to be built by the Standard Company. It further proceeds in its reference to the subways, to use the same language of said 'subways,' in no manner enlarging the work to be constructed, so as to include any or either of the avenues and streets mentioned in the resolution. In this respect the proposed contract is radically defective, and not within the limits imposed upon the board by its own resolution adopted, defining and declaring the territory over which the subways should be built and maintained. A similar defect is found in the contract as to the entire want of any specification concerning the time within which the subways are to be laid."

The contract is then reviewed and commented upon. The decision is very lengthy, and full of legal points and law bearing upon its construction. Altogether it is a rather mixed up matter of decisions and reversals.

Special Meeting.

The Thomson-Houston Electric Company sends the following notice to stockholders:

A special meeting of the stockholders of the Thomson-Houston Electric Company will be held at the company's office, First National Bank Building, 93 Main street, Middletown, Conn., on Saturday, April 5, 1890, at 1.15 P. M., for the following purposes:

To determine whether the stockholders will vote to increase the common stock of the company from 180,000 shares to 300,000 shares; and also to determine whether the stockholders will authorize the directors to dispose of said increase of 120,000 shares (if the same be voted) in such manner, on such terms, and to such persons, as the directors shall deem to be for the best interests of the company.

The transfer books of the company will be closed from March 31 to April 5, both days inclusive.

⁂ A telephone line will be constructed from Fort Randall via Armour to Grand View, S. D.

⁂ At a meeting of the directors of the New England Telephone and Telegraph Company, held last week, a dividend of 75 cents per share was declared, payable on Thursday, May 15, 1890, to the stockholders of record at the close of business on Wednesday, April 2, 1890. The transfer book will be closed from April 3 to May 5, 1890, both days included.

⁂ The Salt Lake City Telephone Company has issued the following circular: "The Rocky Mountain Bell Telephone Company begs to advise you that, for reasons which appear below, it is compelled to announce an increase of rates, to take effect on and after May 1, next. The new rate will be $80 per annum for offices, and $60 for residences, with the usual additional charges on all instruments located over three-fourths of a mile from central office, these being the minimum rates now in force in Denver, Leadville, Kansas City and other similar cities.

⁂ In a recent number of the *Comptes Rendus*, M. Joubin describes some experiments made to determine the magnetic field within a conductor of large section. The conductor consisted of sulphate of copper placed in a vertical glass tube, 18 cm. in diameter, and reposing on a trough of mercury. The upper electrode consisted of a plate of copper placed on the upper surface of the copper sulphate. A small magnet furnished with a mirror was suspended by a silk fibre in the interior of the liquid. When the magnet was placed within a second tube in the axis of the liquid cylinder no force whatever was observed. As the magnet was moved along a radius of the cylindrical conductor the force became greater and greater, and it was found that in the immediate neighborhood of the surface the action was the same, whether the suspended magnet was inside or outside of the conductor.

A Notable Run on the Reading Railroad.—89 Miles in 85 Minutes.

What is said to be the most remarkable feat in the history of American railroading, was accomplished a few days ago on the New York Division of the Philadelphia & Reading Railroad, when a special passenger train covered the distance of 90 miles between Philadelphia and New York in the almost incredibly short time of 85 minutes. The engine which made the record-smashing run is designated as "No. 366." It is of the peculiar type originated by the Reading Railroad, and was built for the regular fast passenger service of the road. The engineer was Frank Wagner, who, when he climbed into the cab, little fancied that he would leave it the hero of the fastest run ever made between the two big cities. No special preparation was made for a fast run, both engine and crew being selected hastily and almost at random to meet a sudden call for a "special." The first revolution of the drivers was made at 11.38 A. M., and the real running began at Wayne Junction, on the outskirts of Philadelphia, which station was passed at 11.44½. From this point the road is peculiarly adapted to the attainment of high speed, being straight, free from heavy grades, and in excellent condition of maintenance. The 54⅞ miles between Wayne Junction and Bound Brook was covered in 49½ minutes, an average speed of 66½ miles per hour. The highest rate of speed reached was 87 miles per hour, and stretches several miles long were run at the rate of 81, 82 and 84 miles, respectively. A little calculation will show the terrific velocity implied by these figures, and to stand the strain involved requires the very perfection of machinery and road-bed. The best previous record made by any train between New York and Philadelphia was that of a special, also on the Reading, which conveyed the late President Gowen on his return from Europe several years ago. The time then made 90 minutes for the 89⅘ miles, and it has never been equaled until now, when Engineer Wagner and "No. 366" have beaten it by five minutes.

American Bell Telephone Company.

ANNUAL REPORT PRESENTED AND BOARD OF DIRECTORS ELECTED AT THE ANNUAL MEETING LAST WEEK.

The annual meeting of the Bell Telephone Company was held in Boston, March 25. The annual report of the directors for the year ending Dec. 31, 1889, was read by the chair. It is as follows:

To the Stockholders:

The reports for the past year of the telephone companies operating under licenses from the American Bell Telephone Company show a continuing increase of business, and a continued extension and improvement of their plant.

The following tables present the statistics in tabulated form:

INSTRUMENTS.

	Dec. 20, 1884.	Dec. 20, 1885.	Dec. 20, 1886.	Dec. 20, 1887.	Dec. 20, 1888.	Dec. 20, 1889.
In the hands of Licensees, under rental	325,574	330,040	353,518	380,277	411,511	444,861
Increase over previous year		4,466	23,478	26,759	31,234	33,335

EXCHANGES.

	1884.	1885.	1886.	1887.	1888.	1889.	1890.	Increase over 1889.
Exchanges	906	772	747	736	739	742	757	15
Branch Offices	419	481	428	446	452	452	471	19
Miles of Wire on poles	.....	88,481	100,332	111,349	127,839	142,631	154,009	11,378
Miles of Wire on buildings	.....	11,886	10,043	10,587	10,225	10,266	11,484	1,218
Miles of Wire underground	.....	1,225	3,417	6,030	8,009	17,038	27,117	10,079
Miles of Wire submarine	.....	.....	254	265	365	536	603	67
Total Miles of Wire	85,896	101,592	114,046	128,231	146,438	170,471	193,213	22,742
Total circuits	97,422	107,440	119,067	121,260	132,004	143,687	156,780	13,093
" employés	4,762	5,168	5,433	5,843	6,183	6,310	6,758	448
" subscribers	123,625	134,847	137,750	147,008	158,712	171,454	185,003	13,549

EXCHANGE CONNECTIONS.

The estimated number of exchange connections daily in the United States is	1,240,147
Or a total per year of more than	400,000,000
The number of daily calls, per subscriber, varies in different exchanges from 2 to 15, the average throughout the United States being	6⅞

The average cost to the subscriber varies, according to the size of the exchange and character of the service, from 2 to 13 cents per connection.

It is seen that the output of telephones was 33,350—2,116 more than the large output for last year. Fifteen new exchanges and 19 branch offices have been opened.

The mileage of wire is 193,213 against 170,471 at the close of the year 1889. A very material increase has been made in mileage of underground wire, something over one-third of the whole amount in use having been put down during the last year.

During the year the American Telephone and Telegraph Company—the long line company—has continued the extension and development of its scheme of lines. It has extended its work from Philadelphia to Baltimore and Washington. It has also completed a second line from New York to Boston, building in 1889 the part from New Haven to Boston, and has entered Eastern Pennsylvania, building lines connecting Philadelphia with Reading, Easton and Scranton. It has connected with its eastern lines Newport, R. I., and Fall River and New Bedford, Mass.

On January 1, 1890, it had 1,918$\frac{33}{100}$ miles of pole line, and 34,799$\frac{40}{100}$ miles of wire on poles, together with 805$\frac{56}{100}$ miles of wire in cables—aerial, underground and submarine—a gain during the year of 700 miles of pole line, and 9,588 miles of wire.

The application to the legislature, to which reference was made in the last report, for authority to increase the capital stock of the company, was favorably entertained and by Chap. 385, Acts of 1889, approved May 29, 1889, it was enacted that the company might from time to time increase its capital, provided the total capital should never exceed $20,000,000. At a special meeting of the stockholders, held September 12, 1889, this amendment was accepted and at the same meeting an actual increase of the capital was made of $2,500,000. This was offered to the stockholders under circular of September 12, 1889 and was all subscribed for, one-half being payable October 19, 1889, and one-half April 19, 1890.

EXTRA-TERRITORIAL LINES.

	Jan. 1, 1884.	Jan. 1, 1885.	Jan. 1, 1886.	Jan. 1, 1887.	Jan. 1, 1888.	Jan. 1, 1889.	Jan. 1, 1890.	Increase during 1889.
Number of lines	598	826	897	911	927	947	969	22
Miles of pole lines	20,592	25,766	30,697	31,143	32,478	34,010	35,254	1,244
Miles of Wire	29,359	35,631	41,745	43,767	56,179	73,293	86,728	13,435

EXTRA-TERRITORIAL CONNECTIONS.

The average daily number of extra-territorial connections is	8,289
Or a total per year of about	2,700,000

UNDERGROUND WIRES IN USE.

	Jan. 1, 1886. Miles.	Jan. 1, 1887. Miles.	Jan. 1, 1888. Miles.	Jan. 1, 1889. Miles.	Jan. 1, 1890. Miles.	Increase over 1889. Miles.
Albany	....	1	1	1	1	.....
Boston	289	347	736	1,580	3,599	2,019
Brooklyn	134	1,233	1,443	2,197	2,254	57
Buffalo	.....	.....	.....	.....	1,170	1,170
Chicago	760	1,462	2,000	3,127	3,255	128
Detroit	.....	82	175	500	871	371
Louisville	.....	9	238	469	780	311
Lowell	.....	.....	.....	.....	4	4
Milwaukee	1	1	.....	.....	.....	.....
New Haven	.....	.....	.....	.....	300	300
New York	627	627	1,120	5,203	10,900	5,697
Pittsburgh	614	966	958	2,370	2,394	24
Washington	992	1,302	1,338	1,591	1,589	*2
	3,417	6,030	8,009	17,038	27,117	10,079
American Telephone and Telegraph Company's long distance wires	.....	.....	140	327	559	232
Total	3,417	6,030	8,149	17,365	27,676	10,311

*Decrease.

The extra-territorial earnings for the year amounted to*	$943,854 88
Of which this company's share is	84,233 18
An increase over 1888 of	4,440 51

*In case of four companies, which failed to report their extra-territorial earnings for November and December, the average earnings for the earlier months have been used to complete the above statement.

The report was accepted, after which a ballot for the new board of directors resulted in the selection of the following: Francis Blake, Charles P. Bowditch, George L. Bradley, Alexander Cochrane, William H. Forbes, Henry S. Howe, Charles E. Hubbard, John E. Hudson, Gardiner G. Hubbard, C. E. Perkins, Thomas Sanders and Howard Stockton.

The mechanical department, with its other work, has continued its study of transmitters, designing new forms of transmitters and telephones, as well as instruments for special purposes. It has also been much occupied with general questions relating to subways and cables and with the problems suggested as the underground work progresses.

The patent division has continued its work of collecting, digesting and arranging information upon electrical subjects and preparing reports based thereon. It has also prepared the applications for patents upon such inventions as have been made by our own people, or bought by us before patenting. It has advised with the Western Electric Company upon its electrical matters and has aided it in the preparation of the defence in certain litigations. It has also to some extent assisted the Bell Telephone Company, of Canada.

The electrical division is continuing its conduct of a series of experiments on different forms of telephonic instruments and apparatus.

The treasurer's statements, showing the ledger balances December 31, 1889, and comparative statement of earnings and expenses for the years 1888 and 1889, are appended, as are also reports of the auditing committee of April 16, July 13, October 29, 1889, and January 14, 1890.

For the directors,

JOHN E. HUDSON, *President.*

FINANCIAL STATEMENT.

Debtors.

Telephones	$827,212 29
Real Estate	472,761 71
Stocks	28,149,361 03
Merchandise and Machinery	12,949 56
Bills and Accounts Receivable	1,488,710 27
Cash and Deposits	1,053,788 15
	$32,004,783 01

Creditors.

Capital Stock	$11,303,900 00
Debenture Bonds, 1888	2,000,000 00
Bills and Accounts Payable*	553,513 60
Patent Account (Profit and Loss)	10,432,362 36
Profit and Loss	3,743,762 93
Reserve	1,820,232 51
Surplus	2,151,011 61
	$32,004,783 01

*Of this amount, $338,913 is the dividend payable January 15, 1890, to stockholders of record, December 31, 1889.

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

Earnings.

	1888.	1889.
Rental of Telephones	$2,453,279 34	$2,657,361 90
Dividends	1,213,856 58	1,230,500 53
Extra-territorial and Branch Lines	78,711 18	93,556 63
Telegraph Commission	21,164 92	22,367 02
Interest	90,466 05	43,964 44
Miscellaneous	7,639 81	7,954 19
	$3,865,118 48	$4,044,704 71

Expenses.

Expenses of Operation	$274,442 00	$269,493 37
Legal Expenses	222,257 75	144,566 62
Interest and Taxes	207,212 68	225,199 97
Commission	467,471 10	511,215 31
Royalty	10,000 00	10,500 00
Concessions	207,790 27	221,288 11
Miscellaneous	61,739 46	3,702 64
	$1,450,913 26	$1,385,966 02
Net Earnings	$2,414,205 22	$2,658,738 69
Misc. Items to Surplus Account	22,258 34	3,150 00
	$2,436,463 56	$2,661,888 69
Surplus Account, Dec. 31, 1888	$2,028,035 92	
Net Earning, 1889	2,658,738 69	
Miscellaneous Items	3,150 00	
		$4,689,924 61
Regular Dividends in 1889	$1,222,913 00	
Extra Dividend in 1889	600,000 00	
Reserve for General Depreciation	600,000 00	
Reserve for Depreciation of Insts	100,000 00	
		2,538,913 00
Surplus Account, Dec. 31, 1889		$2,151,011 61

Telegraphic Recollections.

THE COMING TOURNAMENT BRINGS OUT SOME OLD STORIES.—OTHER TOURNAMENTS, AND WHO WON.

There are about 25,000 telegraph operators in the United States, estimates the N. Y. *Times*, in an article discussing the coming telegraphic tournament. That number includes both branches of the business—commercial and railroad. As a class they are rather clannish. In some of the larger cities there are many who have no acquaintances at all who are not telegraphers. They rarely, therefore, do things that interest the general public. Twice they have rebelled against the harshness of monopolies, and the public has been told a good deal about them. Occasionally one is made a hero for a few days, because he performs some action that saves the lives of passengers on a train. Occasionally, too, one elopes with another man's wife. But it is a credit to the profession, that its members are, by a heavy majority, most desirable citizens. It isn't so long ago that the man who dealt directly with that great mystery, electricity, was a curiosity. That is so now to a certain extent, for, although by this time nearly everybody has seen a telegraph instrument, a man or woman engaged in manipulating one is always regarded with passing interest.

The technical knowledge that is necessary to a speaking acquaintance with the business, precludes the general public from being aware of the fact that among operators there are perpetual contests of speed in transmitting. It is a fact, however. Outside of the novelty—which soon wears off—of being able to converse with some one in a distant city, the possibility of being known as a "fast sender," is the chief attraction of the business to the youthful operator. To him there is not another goal in the world equal to it. He is inclined to pity his layman friends because they have not the opportunity to compete for it. Every time he sends a message, he sends it at top speed. The old-timer at the other end of the wire may complain that the characters he makes are not readable. He may even call him a "ham." But the youth will attribute any such observations to jealousy, and plunge ahead recklessly.

The competition goes on year after year. Men become expert with long and constant practice; then they get lazy, tired of "whooping it up," and devote themselves to doing as little work as possible, an occupation professionally known as "soldiering." But new men take their places. It is a good thing for the telegraph companies. It increases the capacity of their wires. Very often, if it were not for the ambitious ones in an office, it might be necessary to employ more men.

As a result of this continual emulation, hundreds of operators become swift and accomplished senders. It never has been known, however, who was pre-eminent nationally. But it will be very shortly. On the afternoon and evening of April 10th, a grand tournament is to be held in this city, in which any operator in the country may compete. Mr. Fred Catlin, one of the chief operators in the big Western Union office, at Broadway and Dey street, said quietly one day several weeks ago that a tournament was being arranged, and now every operator in the United States knows of it. In fact a great many of them knew of it a few hours after Mr. Catlin had spoken. And, although the uninitiated may doubt it, it was known away down in Albuquerque, New Mexico, about as soon as it was known in Hoboken. It doesn't take very long for news of interest to telegraphers to be conveyed to them. All over the country men are trying their speed, whether they intend to enter the tournament or not, just to show what they could do if they tried.

That same lazy old-timer who wrestled with the youth is having a hard time of it. Whenever he sits down to take a message he gets "salted." His only recourse is to inquire sarcastically of the man at the other end, "Are you practicing for the tournament?" He may flee to the "jay wire," the route of which is through a lot of villages where the operators enhance their incomes by serving also as clerk in the grocery store, ticket agent, milkman, sheriff, school teacher and postmaster, and to whom the sending of a message is a rare episode. Ordinarily these countrymen stagger along at about ten words a minute. In their society the old timer feels sure of relief. But the chances are that the instrument will tick out to him:

"— — — —

* * The Transcontinental Street Railway Company, which has the most extensive system of street railways in Portland, Ore., have decided to supplant horse-power by electricity, and will probably adopt the overhead system.

* * At the last meeting of the Electric Club, of Kansas City, held Saturday evening, T. F. Clohesy introduced a resolution to the effect that the city school teachers and high school pupils, who take an active interest in electricity, be invited to attend any and all meetings of the Club.

* * A scheme is on foot to make University avenue, along the electric line between Minneapolis and St. Paul, a grand boulevard. The avenue is 125 feet wide and could be made very beautiful. It is proposed to make 10-foot sidewalks, a five-foot boulevard, and a 30-foot driveway on each side of a space 20 feet wide running down the center of the avenue. In this central space the electric railway tracks are to be placed.

* * The Massachusetts legislative committee on street railways gave a hearing last week on the petition for a charter for the Milford and Hopedale street railway. There was no opposition to the petition. The capital stock of the company will be $60,000, the location of the tracks to be satisfactory to the selectmen of both towns, and the line not to cross any railroad track without the consent of the railroad commissioners.

* * The Equitable Electric Railway Construction Company, of Philadelphia, have just closed a contract with the North Avenue Electric Railway Company, of Baltimore, for the equipment of this line, which is about two miles long, and to have one car at present. They have just taken an order from the Wilmington City Passenger Railway Company for two new vestibuled cars, each to be equipped with the new Sprague No. 6 motors.

* * Plans for enlarging the electric plant of the Holyoke, Mass., Water Power Company will be prepared this week, and the improvements will cost over $100,000. Pits have already been dug for four new water wheels. Thirteen Schuyler machines are in use at present, nine of them having a 30-light capacity and four of 25 lights each. The city authorities are now arranging to advertise for bids for the lighting of the city.

* * Leading electric companies are showing great enterprise in their increasing efforts toward the equipment of cities and country towns with electric railways, street lights and motors, for every purpose. One of the most novel applications of the motor for power purposes lately is its use for running a horse grooming machine in one of the large stables of Chicago. A three horse-power motor, running 1,650 revolutions at 220 volts, is belted to the machine in such a manner as to cause the two revolving brushes to turn at about 2,500 revolutions per minute.

The Short Electric Railway System.

SOME DISTINGUISHING CHARACTERISTICS OF THE MOTOR.

Our illustrations on this page present a good idea of the Short electric motor as applied to street railway work. Some important improvements have been made quite recently in this machine, and we take occasion to note some of its distinguishing features. The armature is of the Brush ring closed circuit type. Four field magnets, wound in series, are employed. Two solid blocks of wood act as an insulator between the motor and the truck. It will be noticed that the truck frame is depressed and is fitted with rubber springs to cushion the cross girder, which contains a journal box for the free end of motor frame.

FIG. 3.—THE SHORT SYSTEM.—TROLLEY SHOWING METHOD OF SLIDING CONTACT.

Among the advantages claimed for the Short motor are the following: Low speed of armature, only 1,000 revolutions being made when running at the rate of 12 miles per hour. The entire bedding of the wires in grooves in the armature core. This, it is said, prevents all possibility of stripping the armature by the heavy drag through the magnetic field, and also reduces the liability of short circuiting. A constant neutral point for variable currents is maintained, hence no rocker arm is needed for the brush holders. The latter are rigidly fixed on the machine in a substantial way. The armature end of the frame work is deprived of the usual tuning fork characteristics by a strong girder of iron extending between the yokes of the field magnets, and cast in one piece therewith. Consequently the objectionable noise due to vibration is done away with. The method of winding the armature permits free radiation, and it runs without a sensible rise in temperature. The gearing is made noiseless, as well as insulated by using wooden webs, iron hubs, rims and clamps, and it is claimed that this construction not only eliminates the noise, but also, by reason of the elasticity, greatly increases the life of the gearing.

All bolts throughout the motor structure are locked against loosening. There is no wheel on the trolley arm, a properly shaped shoe making a sliding contact with the wire. This is said to greatly reduce the evils of sparking, without appreciably wearing the wire; six months' constant use failing to show a wear of .001 inch on the line wire.

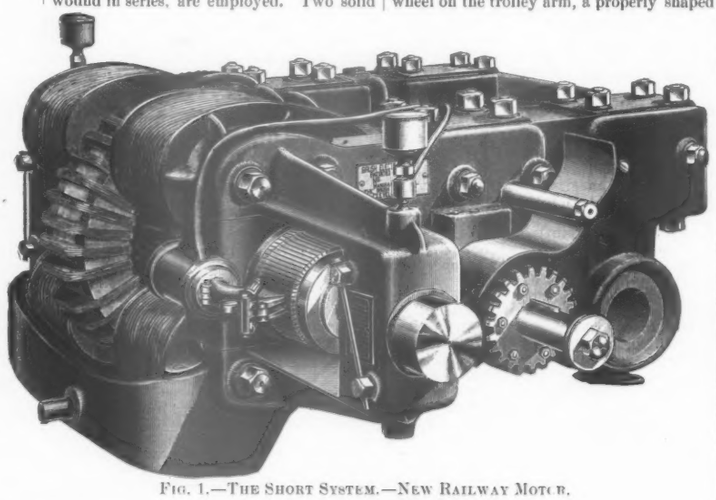


FIG. 1.—THE SHORT SYSTEM.—NEW RAILWAY MOTOR.

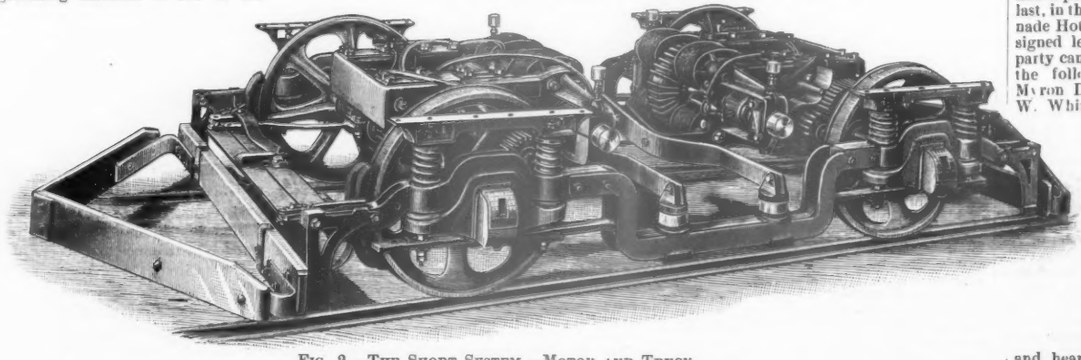


FIG. 2.—THE SHORT SYSTEM.—MOTOR AND TRUCK.

New York Electrical Society.

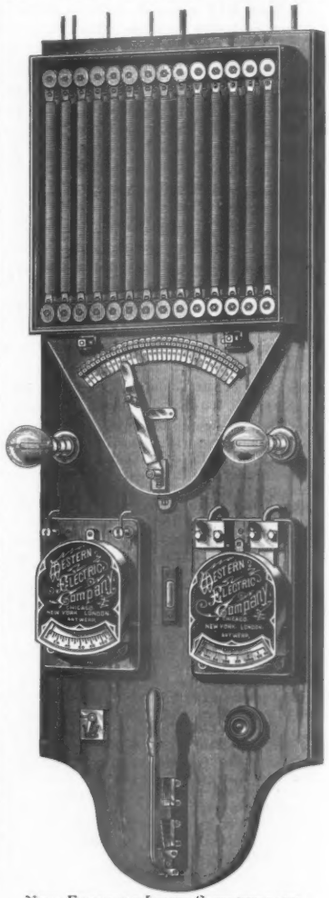
The society was invited last Wednesday evening to inspect the Westinghouse exhibition plant in the Equitable Building, which was fully illustrated and described in a recent number of the ELECTRICAL REVIEW.

Quite a number of the members and their friends were present.

The apparatus was shown in operation, and one of the engineers of the company explained in detail the principles and practice developed in the system.

New Combination Board.

The accompanying illustration shows the dynamo, rheostat, ammeter, voltmeter, ground indicator and main switch, all mounted upon a finely finished hard wood board. All wires are placed and connections are made on the back of the board, and the instruments can be readily placed and properly connected for service. This board, as shown, is furnished by the Western Electric Company with all their incandescent dynamo outfits, where but one dynamo is required, and is a popular feature of their work.



NEW ELECTRIC LIGHT SWITCHBOARD.

Farewell Dinner to a Well-Known Electric Light Man.

The friends of Myron D. Law, for nine years the superintendent of the Brush Electric Light Company, of Philadelphia, gave him a pleasant surprise on Saturday evening last, in the shape of a banquet at the Colonnade Hotel, and the presentation of a well-signed letter of regret. When the dinner party came together, shortly after 8 o'clock, the following gentlemen were present: Myron D. Law, F. A. Lee, J. C. Sager, F. W. Whiting, H. A. Cleverly, J. E. Pentz, W. E. Mellor, C. W. Spear, W. A. Porter, A. J. DeCamp, W. K. Fox, W. A. Drysdale, M. D., C. E. Stump, Wm. McDevitt, L. H. Spellier, F. W. Griffin, H. B. Cutler, A. Shearer, J. E. Shaw, W. S. Griffith, W. D. Marks, D. R. Walker, F. R. Colvin. Letters of regret were read from Mr. C. W. Price and Mr. W. H. Temple, of New York, and others. The committee spared no pains to make the dinner worthy of the occasion, and the toasts were unusually whole-souled and hearty. Mr. DeCamp expressed himself in regard to the loss of one who had worked with him so intimately for the last nine years, and then presented Mr. Law with a handsome non-magnetic gold watch, a gift from the officers and directors of the Brush Electric Light Company, of Philadelphia.

The Alternating Current.

SOME TESTS ON THE EFFICIENCY OF ALTERNATING CURRENT APPARATUS, BY DR. LOUIS DUNCAN AND W. F. C. HASSON —READ BEFORE THE ELECTRICAL ENGINEERS MARCH 18, AND DISCUSSED AT LENGTH.

Several papers have appeared lately on the efficiency of alternating current transformers, some of which have been of a more or less theoretical nature, while others have given the results of actual tests. I have never, however, seen any tests on alternating current dynamos, excepting the experiments made by Dr. Hopkinson and Professor Adams on a de Meritens machine used for lighthouse work. Even the converter tests have given such various results that one can hardly be certain as to the real efficiency.

The introduction of the alternating system has been so rapid and is so rapidly increasing that people are apparently well enough pleased with the results not to bother about the smaller question of the reason for them. But whatever the results may be it is of value to know just where the losses in any system may come in, so that we may seek how to avoid them; if we are succeeding it may enable us to increase the profits—if we are losing it may help us to avoid further loss.

The apparatus, the measurement of which is the main subject of this paper, consisted of a Westinghouse 750-light No. 1 dynamo, with a No. 2 exciter and an outfit of 40-light converters. This apparatus had been presented by the Westinghouse Electric Company to the Johns Hopkins University, and was tested a couple of months ago. The workmanship of the machines is excellent.

The plant consisted of a 75 horse-power Armington & Sims' engine, driving the dynamo and exciter through a Tatham transmission dynamometer. Engine, dynamometer and dynamos were firmly secured to heavy parallel timbers which served as a foundation. The converters were banked on a wooden frame work at a distance of some 30 yards from the dynamo, and their primaries were permanently secured to the dynamo circuit, a switch in the latter serving to cut them off when desired. The ammeter belonging to the plant was put in this circuit and was read when efficiency measurements were being taken. The secondaries of the converters were taken to a switchboard, and then to incandescent lamps mounted on racks.

Power measurements.—The Armington & Sims' engine, supplying the power, worked regularly and satisfactorily, and the governor could be adjusted to give the speed required at the dynamo. The Tatham dynamometer was the one used for power measurements at the International Electrical Exhibition, held in Philadelphia, in 1884, where its accuracy was checked by making with it a determination of the mechanical equivalent of heat. The result obtained in the latter measurement was 772.8 foot pounds per degree Fahr., and show that the dynamometer is practically accurate. A description of the experiments and of the instrument may be found in the report of the test made to the Franklin Institute, but it will not be out of place to briefly describe the apparatus here.

An endless belt, as shown in Fig. 1, passes over the driven pulley, *s*, to the shaft of which the engine is belted, round the pulleys, s^2 and *b*, to the driving pulley, *a*, and back over *b* and *s*, to *s* again. The bearings of the pulleys, *b* and *b*, are in cradles pivoted on knife edges, *c*, at their outer ends, and at the inner ends are connected by links at equal distances on the two sides of a knife edge which supports the scale beam, *w*. The outer side belt passes through the line

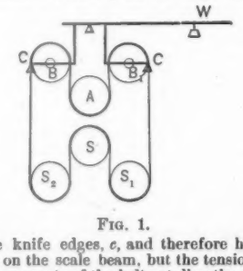
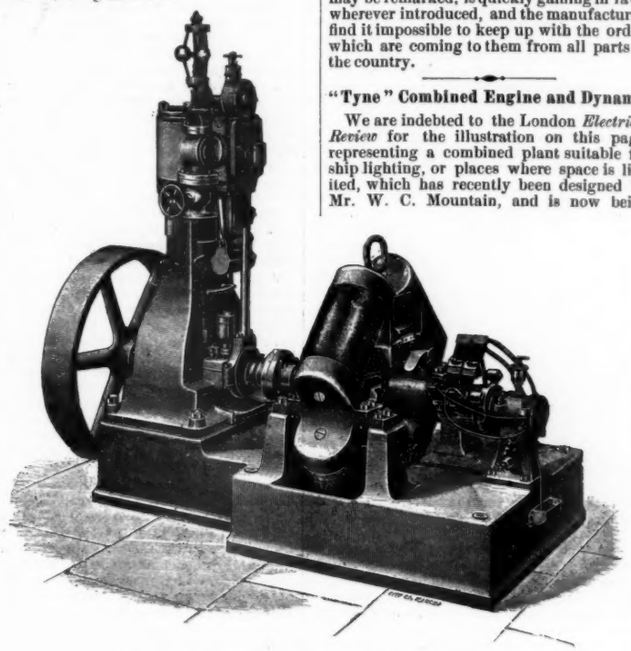


FIG. 1.

of the knife edges, *c*, and therefore has no effect on the scale beam, but the tensions of the inner parts of the belt act directly on the scale beam, and as they are on opposite sides of the fulcrum they act against one another. The beam is so graduated that this difference of tension is read off directly in pounds, and this quantity—the difference of tension of the belt on the two sides of *a*—multiplied by its circumference and speed, give the horse-power delivered. A weight travels on the beam, *w*, and readings can be taken with great accuracy.

Electrical measurements.—The energy in the secondary circuit was measured by means of a Cardew voltmeter and a Thomson ampere balance. As it is not the custom to put a number of secondaries in parallel, each converter had its separate lamp circuit.

Before making an efficiency test, the potential difference in the primary was regulated—there being a Cardew voltmeter in that circuit—and a separate measurement of the potential difference and current in each secondary circuit was made. When the test was actually in progress the voltmeter and ampere balance were used in one of the circuits and the currents and P. D.'s in the others were calculated from the readings in this circuit, together with the previous measurements. Both the voltmeter and ampere balance were accurately calibrated, the former being checked after each test, while the latter had its constant determined with both continuous and alternating currents. The P. D. at the terminals of a non-inductive German silver resistance in circuit with the balance was observed, when a continuous current was flowing, and also with an alternating current of the same period as that employed in the test. The current in each case was calculated from the resistance and P. D., and the results gave no appreciable difference in the constant for continuous and alternating currents.



NEW FORM OF DYNAMO AND ENGINE COMBINED.

The following tables show at once the order in which the tests were carried out and the results:

HORSE-POWER ABSORBED AT VARYING E. M. F.'s.

	E. M. F.		H. P.
	Dynamo.	Exciter.	
Horse-power for exciter, field not made	0	0	.34
" " field made	0	110	.75
" " dynamo alone	0	0	2.73
" " dynamo and exciter.	0	0	3.04
" " " "	0	107	3.51
" " " "	1076	124	12.5
" " " "	1168	104	10 1
" " " "	1099	105	9.60
" " " "	1040	105	9.0
" " primaries of converters on.	1216	105	12.0
" " " "	1171	104	11.8
" " " "	1107	104	11.12
" " " "	1048	104	10.64

TABLE OF EFFICIENCY OF VARYING LOADS.

Approximate load.	Exciter		Dynamo primary.		Converters.		H. P. in lamp circuit.	Mechanical horse-power.	Loss in horse-power.	Efficiency. Per Cent.
	E. M. F.	Current.	E. M. F.	Current.	E. M. F.	Current.				
¼	105	9.4	1107	10.	49.5	153.9	10.21	21.83	11.62	46.8
½	104	10.5	1107	18.9	49.6	338.4	22.50	34.4	11.90	65.4
¾	101	11.	1113	28.6	50.0	520.7	34.9	48.0	13.1	72.7
Full	112	11.5	1123	38.1	50.9	739.8	50.48	64.44	13.96	78.3

EFFICIENCY OF CONVERTERS.

No. 8. 40-*Light Converter.*

No. of lamps.	Volts.	Watts in secondary.	Loss in watts.	Loss in iron.	Efficiency.
40	50.0	2001	109	.....	94.8
0	50.9	0	84	84	.....

No. 4. 20-*Light Converter.*

No. of lamps.	Volts.	Watts in secondary.	Loss in watts in secondary.	Loss in iron watts.	Efficiency.
20	48.8	952	106.	952.	90.0%
15	52 2	817	114.8	108.9	87.6%
10	53.3	506	101.7	99.2	83 3%
5	51.44	264	109.4	108.7	70.7%
0	52.3	0	110.5	110.5	0. %

(*Continued on page* 10.)

An Immense Electric Light Station.

The present capacity of 28,000 lights of the United Electric Light and Power Company, of New York, has just been increased to the extent of 15,000 lights of the Westinghouse alternating current system. To fill this order, five 3,000-light dynamos will be shipped from Pittsburgh. Once these machines are in the station of the United Company and in operation, that organization will have the largest central station incandescent lighting plant in the United States. Its arc lighting business is likewise growing with great rapidity; it is now employing the new Westinghouse alternating current and lighting system to a total capacity of 1,800 lights, and last week was obliged, in order to keep up with the demand for light, to order an additional 125-light Westinghouse machine. This new arc lighting system, it may be remarked, is quickly gaining in favor wherever introduced, and the manufacturers find it impossible to keep up with the orders which are coming to them from all parts of the country.

"Tyne" Combined Engine and Dynamo.

We are indebted to the London *Electrical Review* for the illustration on this page, representing a combined plant suitable for ship lighting, or places where space is limited, which has recently been designed by Mr. W. C. Mountain, and is now being made in all sizes by Messrs. Ernest Scott & Company.

It will be noted that there are many important advantages of this arrangement, the chief being extreme simplicity, stability and accessibility.

The engine illustrated is of the vertical type, the crank shaft running in oil. By adopting this method of lubrication, the engine is capable of running continuously without attention, as the splash of the crank shaft not only lubricates itself and the crank shaft bearings, but also the guide bars and cross head. In addition, however, to this means of lubrication, oil boxes are provided for all moving parts.

The engine is fitted with a Pickering governor and equilibrium throttle valve, and it is found in practice that this governor is capable of regulating the engine perfectly under great variations of load.

The dynamo is of Messrs. Ernest Scott & Company's standard pattern, but it will be observed that the bedplate is extended to form the foundation for the engine. In making the original design for the "Tyne" dynamo, one of the chief features borne in mind by the manufacturers, was to have a massive and substantial bedplate, and it was so designed that should it be at any time desired to make a coupled plant, the additional length of bed could be cast on without any alterations to the standard dynamo bedplate pattern.

The plant illustrated has just been fitted by Messrs. E. Scott & Company, in two large steamers, for the frozen meat trade, each combined plant being capable of giving an output of 100 amperes at an E. M. F. of 65 volts, the speed being 300 revolutions per minute, and it is found in practice that both the engine and dynamo run perfectly satisfactorily at this speed, and require practically no attention. The firm is making a specialty of combined plants similar to the engraving, their standard sizes being for 30, 50, 75, 100, 150, 200 and 250 incandescent lamps of 16 C. P. each, the speeds varying from 400 to 250 revolutions per minute, according to the output of the dynamo. A similar plant is now in hand for lighting a large cold meat store in the Argentine Republic, and capable of running 250 sixteen candle-power incandescent lamps at a speed of 250 revolutions per minute.

ELECTRIC LIGHT NEWS

—— Edison General Electric Company has declared a quarterly dividend of two per cent., payable April 3d.

—— The Consolidated Electric Light Company, of Boston, voted to increase its dividend from four to five per cent.

—— The Cambria Iron Company, of Cumberland, Md., have contracted with the Edison Electric Illuminating Company to have the rolling mills lighted with arc lights.

—— The Edison Electric Illuminating Company has given a mortgage of $5,000,000 on its rights, franchises, real estate, etc., to the Central Trust Company, to secure an issue of bonds.

—— Canton, Mass., will have an electric light plant in the near future. The Westinghouse Electric Company is engaged in installing alternating current apparatus for a 750-light plant.

—— The coal mines at Newcastle, Wyo., are to be lighted by electricity. The entire inside and outside workings will be illuminated, so that the mines can be worked continuously.

—— Barnesville, O., was lighted by electricity for the first time last Thursday night. The streets were thronged with people, the village band turned out, and everybody was happy. The Slattery system is used.

—— At the annual meeting of the stockholders of the Cincinnati Brush Electric Light Company, last week, it was decided to vote April 10 upon an increase of its capital stock from $150,000 to $450,000. The object is an extension of the company's light service.

—— Fort Collins, Colorado, will soon enjoy the advantages which electricity as an illuminating agent affords. The Westinghouse Electric Company has just received an order from Fort Collins, for a 750-light dynamo, and the machine will be shipped without delay.

—— The fight between Jersey City property owners and the Hudson County Electric Light Company is becoming serious. One day last week a citizen drove a laborer employed by the company to put up poles, off his sidewalk at the point of a revolver. The workman took up the flags in front of the citizen's house preparatory to placing a pole there, but was forced to stop at that.

—— Hoquiam, situated in the new State of Washington, is not a very widely known town, but it is an enterprising one. A company to carry on an electric lighting enterprise was recently organized in Hoquiam, and has placed with the Westinghouse Electric Company an order for an alternating current incandescent dynamo of 750 lights capacity and a 50-light arc machine of the new alternating current type.

—— A meeting was held at Columbus, O., last week, by representatives from 30 electric light companies doing business in that State, to protest against the passage of the Adams bill. This is a measure which will practically prohibit the use of any but a low tension electric lighting system. As over $5,000,000 is invested in electric light plants in Ohio, operating high tension systems, the passage of the Adams bill would destroy this business.

—— A rivalry has developed between the new and old electric light companies, which promises cheap light for Saratoga, N. Y., for some time to come. A cent and one-eighth an hour was the rate first quoted by the new company, upon which the old company reduced their rate below one cent an hour, and contracts are being made for lighting stores and hotels at prices very gratifying to merchants and others. It is a merry war of rates, and under-bidding is the order of the day.

THE ALTERNATING CURRENT.

(*Continued from page 9.*)

The efficiency of the converters was measured by placing them in a metal calorimeter, between the double walls of which water was allowed to flow. The temperatures of exit and entrance were observed, as well as the weight of water which passed through; at the same time the current and P. D. in the secondary circuit of the converter were measured. A separate observation gave the radiation which was, of course, allowed for, although it was made as small as possible. A number of converters were experimented on but I give but two of them; a 40-light, such as was used in the tests, and a 20-light converter which was very carefully tested by two of my students, Messrs. Bliss and McKeen. In the latter case the observations were made at slightly different P. D.'s, and the results show that the loss in the iron varies as we would expect it to vary, that is, very nearly as the square of the voltage. The variation will not be exact, as the losses due to the reversal of magnetism do not vary quite as fast as the square of the induction.

I would like here to call attention to the fact that in an excellent paper read before this Institute, Professor Ryan, of Cornell, found that the losses in the iron of a ten-light converter decreased greatly as the load increased. This was accounted for by the fact that there was a jar (evidenced by the singing of the converter) at the higher loads, due to the attractions of the secondary and primary coils. While it is true that the losses in the cores of very small converters are not exactly constant, yet they are nearly so, and a large part of the decrease found by Professor Ryan is due to the voltage being greater at the low than at the high loads.

Looking now at the figures given in the tables we are struck by two things; the very large amount of power absorbed in the core of the armature, and the very small loss in the converters on open circuit. The dynamo losses due to reversals of magnetism and eddy currents, at the E. M. F. used in the test, are no less than six horse-power, while the energy due to reversal of magnetism and eddy currents in the 16 converters is only 1.6 horse-power. Another rather striking thing is the almost constant ratio of primary and secondary currents over a considerable range. The maximum efficiency is about 78 per cent. It would seem that the losses could be divided into a constant part, and only varying with the current, but this is not true with the older style and smaller converters of the Westinghouse Company.

Suppose we have a plant, such as is described above, and use it for commercial lighting. Taking data from one of the local companies employed in supplying incandescent lights on this system, we have, for two 2,500-light dynamos, the following outfit of converters:

Size of Converters.	Capacity.	Number in use.	Total Lamps.
No. 1,	5 16 c. p. lamps,	44	220
No. 2,	10 " "	61	610
No. 4,	20 " "	43	860
No. 6,	30 " "	49	1,470
No. 8,	40 " "	64	2,560
Total lamp capacity			5,720
Number of lamps supplied			4,557

I understand that the converters being added are of the larger sizes.

The efficiency of the 30-light converters does not differ greatly from that of the 40-lighters. The following is a load diagram of this plant, selected from a number of diagrams, as giving a fair average curve. If we have our dynamo working to its full capacity, then from the above data we would have a converter capacity of 23 40-light converters:

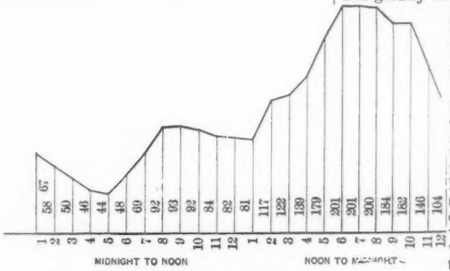


FIG. 2.

If, as in our test plant, these converters are 40-lighters or 30-lighters—for the efficiency of these two sizes is about the same—we would have a mean loss in our plant of, say, 10 horse-power in our dynamos ($9.6 + C^2 R$), and in the converters about 3 horse-power ($2.3 + C^2 R$); or altogether about 13 horse-power. From the above table we will have 750 lamps supplied, and taking the data from the load curve the average load would be in the neighborhood of 1,300. This corresponds to about 20 horse-power, and the efficiency of the plant for 24 hours would be $\frac{20}{33}$ = 61 per cent., minus the percentage of loss on the lines. This, in a properly installed system, should not average two per cent., so that the final efficiency would be 59 per cent.

A continuous current dynamo supplying the same outfit of lamps, with a maximum loss in the mains of, say, 15 per cent., would have a greater average efficiency. But I wish to point out that the maximum efficiency of the two plants would be about the same, so that they would require the same capacity of station outfit, boilers, engines and dynamos, etc. When more than one dynamo is provided the efficiency is increased by using only one of them during the times of minimum supply, and always working, as far as possible, only a little below the maximum capacity of the machines.

Let us consider these results in view of the present condition of incandescent light distribution in the United States. I take it that what may be called domestic electric lighting is largely a matter of the future—it is certainly not a matter of the present. The majority—the great majority—of the lights in use are in shops, saloons, theatres, offices, etc. Most of the lights wired are in use at one time or another during the 24 hours, and the proportion of energy supplied to the total capacity of the lamps connected is much greater than it would be in the case of house lighting, where, on the average, only a small fraction of the possible lamp hours are actually in use. Under these circumstances the scheme of alternate current distribution is very different from what it will be when the attempt is made to supply an entire city with light, as they are attempting to supply London at the present time.

If the object of the lighting company is to supply the demand that exists at present, then a system employing a number of small converters is preferable. Such a system is flexible and can be installed with a minimum expense for the more or less scattered demand which is presented in even the most closely settled town. I take it that this is the great difference between the alternating and direct systems as at present installed in this country. The former skims over an extended district, taking advantage of its great flexibility to absorb any business which can be got; while the latter settles itself in a densely built center, installs a larger plant than is primarily demanded, and works up a business within the limits of economical distribution. Therefore, it is hardly right to compare the present systems of direct and alternating supply, as the latter has not been reduced to a point where entire districts are to be supplied.

To show the disadvantage of the present system for domestic supply, suppose we have an ordinary house such as one of us would live in; it would be necessary to have a converter of at least 20 lights capacity. The constant loss is, say, 100 watts; so, leaving out the $C^2 R$ loss, we would have a total loss in 24 hours of $\frac{2,400}{750}$, or about three horse-power hours, corresponding to, say, 45 lamp hours. Taking my own experience, the actual number of lamp hours used is about 30 lamp hours during 24 hours, so the efficiency of the converter would be something like $\frac{30}{75}$ = 40 per cent. It is evident that unless the losses in converters can be greatly decreased, a house-to-house distribution with a converter in each house would hardly pay.

It would seem, then, that if gas is to be really displaced, and serious competition with it is to be attempted, a different system of distribution must be worked out. We must replace the numerous small converters with one large converter supplying a comparatively extended district, thus decreasing the converter capacity, since the law of average can be taken advantage of, and greatly increasing the efficiency. If an extended secondary network is employed, some of the converters may be disconnected from the mains at the turn of minimum demand.

Let us inquire for a moment how the increase in the capacity of converters will modify the designs with which we are familiar. In the first place, if we increase the linear dimensions of any type, since the radiating surface only increases as the square, while the volume increases as the cube of the dimension, then we cannot suffer the same loss per cubic centimeter of the iron for large as for the small sizes. We must decrease the intensity of magnetization or we must decrease the periodicity.

Let us take a typical case. Suppose we have a transformer and double all of its dimensions. If we employ the same induction we will need but one quarter the number of turns in the coils, and as the cross section of the space occupied by the wire is four times as great, the area of the wire may be 16 times as much. As the length is twice as great, the resistance in this case is one-eighth. But the losses in the iron are, roughly, eight times as great; this we cannot allow, since the radiating surface is but four times as great; hence we must diminish the induction. In fact we must so arrange things that the loss in the larger converter is only four times that in the smaller, in order to work at the same temperature. As at the low induction used the loss due to hysteresis varies nearly as the square of the induction, we may take it roughly that the large converter should have an induction of three quarters of the smaller one. This will modify our figures. Instead of one-quarter the number of turns we will have one-third, and the resistance of the coils will be one-sixth instead of one-eighth, as we can allow four times the loss that we suffered before, we can have, roughly, five times the output.

As a total result we have five times the output with four times the loss, or, as the $C^2 R$ effect is not important as compared with the other losses, we can have six times the output with the same fall of potential in the secondary. That is, the efficiency of the larger converters will be greater than the smaller ones of the same design, and working at the same temperature, but the output per pound of metal will be less.

Suppose when we increase the size we decrease the number of reversals. Take a case, for instance, in which the dimensions are doubled while the reversals are halved, the maximum induction remaining the same. We could have half the turns in the coils, and as they occupy four times the space and are twice as long, the total resistance would be one-quarter, and for the same heating effect we would have four times the output.

If we take losses by eddy currents into account, there will be a constant per cubic centimeter, provided the period and maximum induction are constant, and the thickness of the plates is unchanged; otherwise they will vary as the square of the induction, with a constant frequency, or inversely as the square of the period with a constant maximum induction. This, in practice, would make the values of the output for the larger currents, given above, somewhat greater. What I wish to show, however, is that we are limited by heating considerations, and considerations of fall of potential in our secondary, in the output of large converters. If we consider the properties of the materials of which converters are made, we would, I think, find it most economical to make converters that reach the temperature limit, except for the very smallest sizes.

Many of us have, I suppose, read Mr. James Swinburne's paper read before the British Association at Newcastle last year, on the "Design of Converters," and have been struck by the fact that almost all of the converter dimensions given by him are impracticable, either on account of the disproportionate heating of the larger sizes, or the excessive fall of potential in the secondary. In increasing the size of dynamos we usually increase the output per pound weight, but there is the vital distinction between dynamos and converters that losses occur through the entire mass of the latter, and as we increase the volume we increase the losses in the same proportion. In the dynamo, on the contrary, there are practically no losses in the heaviest part of the apparatus, *i.e.*, the field magnets. As a result, while we gain in efficiency in the larger sizes, yet we must decrease either our induction or the rate of reversal, and the output per pound is not increased.

DISCUSSION.

The Chairman (Vice President Francis R. Upton): Gentlemen, you have heard a paper that brings a new set of figures and measurements before the electrical world, and with such accuracy that they will probably stand as facts for certain constructions of apparatus. This paper, of course, brings up the broader questions—the question of alternating and direct currents, and, as far as their economical bearing is concerned, I think discussion directed to this point would be in order. We have Professor Anthony with us to-night, and we should be pleased to hear from him.

Prof. W. A. Anthony: I would prefer to wait and hear some of the others talk about this matter. Alternating currents I have never had anything to do with, practically. There are people here to-night who have had to do with them, and who know more about the results.

Mr. Nikola Tesla: Dr. Duncan has brought forward some facts which have not been recognized before; for instance, the fact that the loss in the iron of the converter remains perfectly c nstant with varying loads. That has not heretofore been acknowledged or known, so far as I have heard. But, on the other hand, when we consider the action of the converter, I think it ought to be. In converters in which the primary and secondary are put in the closest possible relation—for instance, in the Westinghouse—the increase of the primary and secondary is in an almost constant ratio, and since the loss in the iron is due to something like a difference in action of both currents, I think the loss of the iron ought to be constant within certain limits. With regard to the excessive loss in the dynamo machines—in the armature that Dr. Duncan has found—I think that most of us know that this loss is not due to the fact that we must have that loss, but because we must sacrifice a certain amount for the regulation of the machine." Now, the same machine that Dr. Duncan has tested, any one of us could cause to give a greater output and with a loss in the armature of no more than one or two horse-power. But we must work with a highly saturated field in order to obtain a constant potential on the converters. On the other hand, the comparison between the single circuit alternating current and the direct current machine is just, and the proportion, I believe, will be about as Dr. Duncan found them. That is, if we compare a single circuit alternating machine with a direct current machine we will find, representing the output of the latter by a number, say 100, that the alternate current machine with one circuit will give for the same speed and weight about 78 or perhaps less. But we must also consider that we are enabled with alternating current machines to work at a very much higher speed, and the simplicity of the apparatus allows us to work with a very much higher electro-motive force. On the other hand, if we operated an alternating machine with two circuits, then the output of the machine will no longer be inferior to the direct current machine, but it will equal it, if not be greater. I believe that Prof. Anthony, some time ago, told me that he also found that the loss in the armature by higher field saturation increased more rapidly than we would generally suppose. I have found also if you take a large generator and saturate the field very highly, we may, by only a few revolutions in a few minutes, heat the armature so that the wires will burn out. I think the losses in the armature increase very greatly with the saturation of the field. Now, as regards the general results obtained by Dr. Duncan, I am firmly convinced of their correctness, of course, but I also firmly believe that Dr. Duncan has not had the best converter in hand. For I have myself made tests, and others have made tests, where the efficiency of such converters is shown to be much higher than is shown by Dr. Duncan. With the improvements we have made lately, I believe that the new converters have now reached a much higher efficiency.

Mr. H. Ward Leonard: We had some theoretical discussion relative to comparative efficiency of the continuous and alternating currents at Chicago, a couple of years ago. At that time we had very little besides theory to work on, especially as regards our knowledge of anything in the alternating field. But I was a little interested in looking over the figures which at that time were arrived at theoretically and comparing them with those which have been obtained. The claim for the continuous current efficiency which was made there was based on a maximum loss of 20 volts on a three-wire system, on each side, that is 15 per cent.; and the average load was considered as 40 per cent. on that maximum. Therefore the average loss in the conductors was considered as six per cent. for 24 hours, that is an average efficiency of 94 per cent. With the generators operated as they would be in such a system at full load, by cutting off such generators as were not needed, assuming an efficiency for the conductor of 94 for the feeders, one per cent. average loss in the mains, one per cent. average in the service and inside wiring, brought the total efficiency of the continuous current system to a figure of 84$\frac{7}{10}$. With the alternating current system the lowest efficiency that was assumed on account of the much higher figures that were claimed was 85 per cent. for the generator, 98 per cent. for the feeder, 90 per cent. for the converter, 99 per cent. for the services and inside wiring, which gave for the total efficiency, 74 per cent. I was not fortunate enough to hear the actual efficiency which the present three-wire systems showed; but I remember that the Professor gave the efficiency of the alternating as 61 instead of 74. I think that a point which is perhaps the most pertinent, and which has been pretty well emphasized of late, is the fact that the average load of a system of lighting generally through a city, is such a very small percentage of the connected devices. I know of one instance where the lighting has not yet reached the condition, which it will later, as regards supplying a much larger connected load than it has at present. And yet the average load for 24 hours is only about 12 per cent. of the connected load. This, of course, brings into very forcible action the efficiency of devices which are low in efficiency under conditions of light load. In the case that I mentioned, the maximum load is 80 per cent. of the connected devices, and the average load is 40 per cent. of that maximum.

S. S. Wheeler: Although I may not be able to add anything to the subject of con-

verters, I might say something about the effect of alternating currents in parallel wires. There was a case in this city of some lines which ran parallel a long distance, and where the current jumped up and down continuously, causing the lights to beat just as if they were driven by a steam engine which did not have a heavy enough fly wheel. These wires were about three miles long and parallel, and after a very extensive investigation, it was found that the jumping of the lights was due to the alternations on two circuits being nearly, but not quite synchronous; so that when one set of waves caught up with the set of waves on the next wire while passing them, they first drove those waves ahead and then drove them back. This caused the energy of one circuit to first pile up the energy in the other circuit, and then force it down and thus cause a jumping effect on the lights. That was overcome entirely by placing the wires in pairs properly. That is to say, the two legs of each circuit had not been arranged side by side. One or two of the circuits had been misplaced. But by bringing those together, so that the negative side or leg of one circuit was right alongside of the other leg of its own circuit, and not mixed up with the wires of any other circuit, the induction was completely neutralized, and that left the lights perfectly steady. This has nothing to do with converters, but is about the only thing that I can contribute to the subject. It was quite important. The lights jumped very badly. The company was very much troubled to know what the cause was. I had been formerly driving Edison dynamos with high speed engines, and I laughed at the people who were running the lights, and assumed that their flywheel was not heavy enough. They suggested that I should go and try the fly wheel. I made them buy a very expensive speed indicator, and put it on, and about as soon as they got it running I made up my mind that the inertia of the indicator mechanism would be too great to allow it to respond quickly enough, that is to say, if the steam engine made about 74 revolutions a minute, as it did, and if its speed varied enough to show a flickering in the light which would be about two per cent. variation in the middle of each stroke of the engine, it would not be easy to get a speed indicator needle which would show such brief, rapid and small variations as two per cent. variation on every stroke—that is, in less than one second for each. I then tried figuring out the weight of the fly wheel, and how much speed ought to increase or decrease between the strokes. Assuming the fly wheel weighed 30 tons, and had a diameter of 30 feet, and 500 horse-power was being drawn off by the belt continuously, and was being put into the fly wheel twice in every stroke by the brief impulse of the pitman, with no source of power in the intervals, how much would the wheel slow down in the 74th of a second? In other words, how much would 500 horse-power slow down a 30-ton fly wheel, of 30 feet in diameter in the 74th of a second. About the time I made up my mind that this would be a long matter to figure out, I decided to try the plan of a substitution, that is, to change all the elements of the system, one after the other, until I found to which element—for example the dynamo, the lines, or the engine—the trouble was due. We therefore tried driving the different dynamos by different engines and connecting different lines on to different dynamos. We then found that the trouble went with a particular wire. That surprised me. I had gone so far in the matter then that I decided I was in honor bound to see it through. I went out and counted the number of pulsations in the lights, and found that they were about 80 to the minute. I had inspections made and found there were only two parts of the city where the lights jumped in this way, and I then immediately compared the pulsations of the other set of lights and found they were 80 to the minute, the same as the first group. I then concluded there must be some reaction between the lines supplying the two districts. Following the wires out, I found that the two sets of wires that supplied these two groups of lights, were placed in a position where they could act inductively on each other while the others were so placed that they could neutralize their own effects, and I suggested that one set of wires be changed about. This was done and there was no more jumping. It was clearly due to one set of alternations "beating" with the set on the other wire.

Mr. Tesla: A point mentioned by Dr. Duncan was, how the construction of the converters would be modified when their size is increased. I had hoped that Dr. Duncan, whose work in that line has always been so valuable, would give us some points on that. It is evident to every one that it is impracticable to increase the size of the converter in the same proportion as its capacity is increased, because as we operate the converters at a constant number of periods, we would render a long magnetic circuit transformer very inefficient. A plan was proposed by me, a year or so ago, to introduce this system in the construction of converters; to have the same length of magnetic circuits, no matter whether the converters is large or small. I believe that this would be the proper way of constructing all converters on one system, and I believe that the present method of constructing converters is not right, for every different capacity of converter has a different length of magnetic circuit, and we know well if one converter is adapted to, say, 16,000 reversals, another one, with a different length of magnetic circuit, is not adapted to the same number of reversals. We started a year ago, I think, to make all converters of the same length of magnetic circuit, so as to render them equally adaptable for the same number of alternations, no matter what their capacity is, and in such a case, if we want, for instance, a converter that has ten times the capacity of a small 20-light converter, we will practically put in one converter so many multiple circuits as are required to get the capacity desired. We will allow a somewhat greater capacity to maintain the converters all at the same temperature. I believe that this plan should be followed. In general, I may say that the results obtained by Dr. Duncan refer to an apparatus considerable time in use, but the advances that have been made in that line the last year only, are so enormous, that we would not recognize this plant at all. For instance, I believe that the converters at present can be made to have less than half the leakage that they had previously. In other words, it means, practically, you can run a converter with a double load—the machines are increased very nearly to double their capacity; and when we consider the short interval in which this has been accomplished, we may fairly assume that in a few years from now there will be little difference between the alternating and direct current, even on short distances. We will wait for that development in the meanwhile.

Dr. Duncan: In respect to the construction of converters, of course, in increasing the dimensions in the same proportion, I was not following out the proper design for every given converter. Every converter has its own proper dimension, and all dimensions do not increase in the same ratio. But I think that Mr. Tesla's idea of keeping the same length of the magnetic circuit is hardly proper. I have worked out for my own amusement the design of a number of converters, and I think that the same period should be retained in the circuit, and the converter should be designed, which would give the maximum possible efficiency. For a converter of given capacity, as far as I can make out, you must have a definite period. There is a definite period which, with the given proportions of iron and copper, correspond with the given capacity of converter, but if you simply increase the cross section of the iron without increasing the length of the circuit, you keep the same cross section of copper, which is not a good practice. You have to change both the copper and iron, and I did not think it would be very interesting to design a large number of converters for any given output. As for the efficiency of this plant which was tested; the plant was sent on, I think, in November, and was supposed to be the latest plant which was produced by the Westinghouse Company. I have since heard that the efficiency of converters has been greatly increased. The losses in the converters could undoubtedly be greatly decreased, especially for larger sizes. As to the relative efficiency of the two plants, it must be remembered that I have simply taken a 750-light plant, and one dynamo is supposed to be always connected with the circuit in a station of ordinary capacity, that is, of more than twice 750 lamps. We would certainly have the advantage of having at least two dynamos, one of which could be disconnected when the load had reached its minimum and the efficiency, therefore, would be greatly increased, and, also, in comparing efficiency of alternating and continuous plants, we must remember that the business that is catered to by these two plants is very different; that the low diagram of the alternating plant is very different from the low diagram of the continuous current plant. There is a great discrepancy between the curves and the figures of the two. An alternating plant takes up the cream of the business, so to speak. It takes up business in which they get the maximum output for a given number of lamps wired, and in that way we must not calculate the efficiency of the alternating and continuous current plants in order to compare them. If so, we are favoring the continuous plant very much. With the alternating current plant it is simply a commercial question. If you can put into a continuous current station an alternating plant which will get business that will pay you, it is undoubtedly proper to put that plant in. In the same way if you have an alternating plant and it is so situated that you can run more economically with a continuous current plant, then put in a continuous current plant. But as the business stands at present, a combination of the two plants is undoubtedly theoretically the most efficient.

Mr. O. T. Crosby: I should like to ask if the advances reported are in the direction of increasing the efficiency of the converter at all loads, or only at some normal loads?

Mr. Tesla: I said before that the leakage was reduced to one-half, and I thought it was clear enough that that applied as well to the working of the converters on the full load as on the small load. When I speak of leakage I mean no load at all. But Dr. Duncan said just now—I thought he misunderstood me in regard to the construction of these converters—I proposed not to keep the length the same and to vary the section, but simply to vary the section of the copper, at the same time varying the section of the iron. We have plates, for instance, which contain so many multiple circuits. These plates are so made that the coils can be just as well put in as one single circuit transformer, a form of construction invented by Mr. Albert Schmidt, of the Westinghouse Company, and in this way we have practically a number of independent transformers, and the only diminution of the capacity of such transformers is that we have got a somewhat smaller surface. Then we may allow a little higher capacity for that diminished surface. That is all. I think the point is very clear, and there is no doubt at all that this construction should be followed.

Mr. Frederick Darlington: There is one thing which I think merits attention in the discussion of this question, that is, that one system uses the 50 volt lamp, and the other system is forced to use a 100 or 110 volt lamp, and that by the same skill of construction of lamps and the same advance in the art of manufacturing lamps, the 50 volt lamps represent about 20 per cent. more efficiency upon the 100 volt lamps. That is found in practice. For instance, the 100 volt lamps which are being supplied now by one of the large commercial manufacturers of lamps are six-tenths or a fraction over six-tenths of an ampere and 100 volts; while the manufacturers of 50 volt lamps make a 50 watt lamp, and get 50 volts out of the lamp and a better service for the time. I can tell of results that have been obtained by the Westinghouse Electric Company recently in the improvement of converters. They were manufacturing, for a considerable time, a converter that gave a leakage of $\frac{12}{100}$ on every 40-light converter, and they have recently, since certain analyses have been made of the iron, and the quality and the method of annealing the iron has been improved, reduced that leakage from $\frac{12}{100}$ to $\frac{7}{100}$ of an ampere, and the point that Dr. Duncan mentions that, in putting in the alternating system, they are able to take out the lamps in the service—certain circuits, one gentleman said, only about 12 per cent. of the total number of lamps burning on an average—I can state what is given here in New York in the service of the United States Illuminating Company. They are getting out of the total amount of lamps wired on a circuit $5\frac{1}{2}$ hours per lamp, which is about 23 per cent. All these points, I think, if taken into account, will make the efficiency of the alternating current come much higher than would appear at first thought.

Mr. Tesla: Another point of great importance is the fact that in the alternating system you have got an apparatus of almost ideal simplicity. If the armature burns out it is a matter of a few hours work; and the repair costs very little. If any part of the apparatus gives out, it is easily replaced without trouble. With a direct current system I think on the average out of 100 armatures, if you take them on a year's run, there will be about 50 that will have some trouble or other. The commutator will wear out in a few years even with the best attention—I speak, of course, of the average.

Lieutenant John Millis: I believe in all the alternating systems that are now in practical operation in this country the rapidity of alternations, that is, the number per second, is practically the same. I would like to inquire what are the considerations which have determined this rate of alternation, whether they are mechanical or electrical, and if so, if Dr. Duncan can briefly explain to us what they are, also what the effect would be if the rapidity of alternations were varied. He touched lightly upon the theory of the effect that would be produced in the output or efficiency of the converter if the rapidity of alternation varied. I would like to ask if this theory has been confirmed by him, or to his knowledge by any one by practical experiment and what the result of the experiment is?

Dr. Duncan: By the English system I think the rate of alternation is determined very greatly by the size of the unit in which the distribution is made. For large units a low rate is commonly employed. You will find in most of the Continental and English systems that the rate of alternations has been decreased as the size of the converter has been increased. For a large converter a comparatively low rate should be used and as in this country small converters have generally been employed, the rate is very much greater than where the converter has been large.

Mr. Townsend Wolcott: Dr. Duncan referred to Prof. Ryan's paper and his idea in regard to diminishing the energy absorbed by hysteresis by vibrating the iron. Mr. Kennelly seemed to have the same idea as Prof. Ryan, that you could get rid of the waste of energy very largely. The diagram of the hysteresis for one period as drawn by several experiments is as shown in Fig. 11 of Prof. Ryan's paper, one point at the bottom and the other at the top. Now, if you can come back by the same path as you go, of course, the energy is zero. But Mr. Swinburne divides the hysteresis and ordinary hysteresis. Previous to the presentation of Prof. Ryan's paper I had the impression that the whole hysteresis worked in the manner which Mr. Swinburne calls viscous hysteresis; that is, like friction, it would resist in both directions. Mr. Swinburne's idea seems to be that the energy absorbed depends, to a great extent, upon the difference of phase between the magnetism in the iron end and the magnetizing force of the current.

Dr. Michael I. Pupin: I would like to ask Dr. Duncan whether he knows of any experiments that have been made lately for the purpose of finding out how much of the lost energy is due to eddy currents and how much to magnetic hysteresis. As far as I am aware, there has been no experimental work of that kind done, and that has been spoken of as a work which it is very desirable to do to determine the ratios between the two. I think that would also give us a means of testing whether work lost on account of magnetic hysteresis is the same for every period—whether they obtain the same current as shown in the diagram referred to by Mr. Wolcott.

Dr. Duncan: I am not prepared to give any figures on that, because I am experimenting on it at the present time. I am working now to weed out the eddy currents, and to determine the effect of hysteresis for different periods of reversal. There is no data, at present, to tell whether the loss on the iron is due to viscous or static hysteresis. If we go through that change in magnetic force at a very low speed, then hysteresis, due to time hysteresis, will not come in at all. If we go at the present speed it will come in.

Mr. Leonard: I take the liberty of speaking for a second on the question of a five hour load. I had been brought to select in the instance I noted, the most exceptional one I knew of as being the future condition of supplying loss of all kinds. In New York city, which, of course, is the most exceptional in the other directions, the Edison station here has, instead of five, nearer eight hours average load, which, however, may be somewhat due to the advantages derived from the sale of motive power.

Mr. Justus B. Entz: I would like to inquire if the losses due to eddy currents and hysteresis could not be determined by different thicknesses of disks. By taking two readings and separating them, I think it could be determined—the loss due to the eddy currents, of course, varying as the electro-motive force. If the thickness of the disk is doubled, the potential is doubled, while the resistance making a watt load in each disk, varied as the cube, and if the disk in the converter were double in thickness, and the same amount of iron, and the loss measured in the two cases, I should think they could be separated.

Mr. Tesla: I should think, gentlemen, that if hysteresis is a distinct element in the loss of the converter, it can be only so because it is intimately connected with the generation of the currents in the iron. We cannot go beyond a certain thickness of the iron—say number 38 or 40, which may be yet thick enough to give rise to the currents in the iron. But the results that Dr. Duncan has to-day brought out strengthened me in the idea which I always had that ultimately the whole loss in the iron resolves itself into the loss due to the currents. The facts he finds show that the principal loss is due to the eddy currents. The loss to the iron is constant at all loads; on the other hand, he finds that the loss is proportioned to the square of the electro-motive force, which would be precisely the case if the loss in the iron were due to eddy currents. I think that is an argument for this view.

Mr. Crosby: It seems to me in that case that we want to know something of the subdivision of the iron because by a very slight sub-division we might get the eddy currents so predominating over the other effects that it might be when the sub-divisions were finished that they would appear as perhaps the larger effects. I should like to ask Dr. Duncan what the cubic contents of the iron masses were whose total loss is given in the paper. It may have been stated, but I did not hear it.

Dr. Duncan: I think it, possibly, in the paper. If not, it is somewhere else and I would be very glad to give it to Mr. Crosby. As to distinguishing between the hysteresis and eddy currents with different thicknesses of plate, unfortunately, Ewing has found that as far as this time hysteresis is concerned, it depends on the thickness of the plate independent of the eddy current. So, it would be impossible to distinguish in that way.

ELECTRIC CLUBS.

INCIDENTS OF ELECTRIC CLUB LIFE IN THIS COUNTRY—GOSSIP FROM BOSTON, CHICAGO, AND OTHER CITIES—NEW YORK'S POPULAR CLUB HOUSE A NATIONAL MEETING GROUND.

The "Electrical Review" recognizing the importance and value of the electrical organizations of a social-scientific-practical nature, which have been formed in a number of leading cities as local centers for electrical men, will present from time to time the current news and gossip that find their source in these progressive bodies. The New York Club, which has the honor of being the father of Electric Clubs and world-wide in influence and membership, is rapidly becoming the national headquarters for electrical men, and members of similar organizations in other cities are sure to find acquaintances and hearty welcome within its hospitable and handsomely decorated walls. We think this new feature will prove a popular one, and the REVIEW and its staff will spare no means to make it interesting and valuable.

New York Electric Club.

The Annual Election occurs April 17, and promises to be largely attended. There is no opposition to the present president, who highly deserves a re-election, and who was nominated by acclamation. President Madden is now in Paris, but, if his good ship arrives in time, will be here for the annual meeting.

Several changes in the vice-presidents and board of managers of the Club, were made at the nominating meeting. It is thought that the ticket nominated will be elected. But the history of the Club's elections is that the ticket "scratcher" is a success, for the regularly nominated ticket has never yet been elected in entirety.

Recent Callers from out-of-town were Chas. A. Brown, of Chicago; Major J. M. Brown, of Washington; Col. A. B. Uline, of Albany; R. T. McDonald, of Fort Wayne; J. H. Reid, of Chicago; I. H. Davis and J. N. Pratt, of Boston; Hon. Chas. Selden, of Baltimore.

New Stories with an electrical application quite often make their introductory bow at the Club. H. L. Storke, known as the "Pooh-Bah" of the telephone business, is to be credited with the following, which he told as applicable to recent electrical consolidations in this city and rumors of consolidation: An English father, whose son John was in India, requested that information from that distant point be made by cable, but briefly, as the tariff for messages was so high. Soon this came: "John dead." The father, overcome with grief, but realizing the importance of being consistent with his own instructions, cabled: "Send body." In due time a very large box arrived, but instead of finding his son's remains a large tiger was uncovered. Feeling sure that a mistake had been made, the father replied: "Wrong box. Tiger inside." The laconic reply was ample: "Right box. John inside tiger."

The Lecture by Hon. Grosvenor P. Lowrey, on "Patent Law, and What Constitutes an Invention," has interested a great many besides members of the Club. The demand for copies was so great that the Club's issue of pamphlets was exhausted, and the author, to supply the demand made on him, printed a large number of additional copies. The lectures this season have been particularly valuable and timely, it being the idea of the committee in charge, instead of having a set course of lectures, to engage expert speakers to address the Club on topics of special importance at the time, and this has proved so far to be a very successful idea. There will probably be one more lecture delivered before the summer vacation.

New Members are constantly joining the Club, and now that the withdrawals on account of the increase of dues have probably all been made, a steady growth may be expected as long as the Club continues to occupy its present important and influential position.

The Many Friends of ex-President E. T. Gilliland will all regret to hear of his continued ill-health. Mr. Gilliland has been one of the most capable and earnest workers in behalf of the Club from its inception, and has the credit of making the largest individual subscription to the Club's finances.

A cabinet telephone set has been placed in the Club, through the courtesy of the Metropolitan Company, taking the place of the former wall instrument. The change is one greatly appreciated by the members.

A new painting by a well-known artist has been added to the collection in the front parlor of the Club, sent in by Vice-President Theo. N. Vail.

The meetings of the board of managers of the Club are more largely attended than at any time in the past—a good indication of the interest taken in the Club's affairs.

Boston Electric Club.

The membership list is steadily increasing, and the financial standing of the Club is excellent.

The next regular meeting of the Club will take place on Monday evening, April 7. Matters of importance will be discussed, and several new members enrolled.

A pool tournament is in progress. Messrs. Frank Harrington and G. F. Steele are the leaders for first prize, neither gentleman having lost a game thus far in the series.

"Crank's" Dinner—so called—occurs every Friday evening, and is well attended. Those who seem to be particularly fond of "crank" diet, are among the most popular and distinguished members of the Club.

Among the Visitors at the Club rooms during the week, were the following well-known gentlemen, viz.: Mr. Clarence E. Stump, Mr. George O'Keaite Manson, Mr. J. J. Ghegan and Mr. Charles McLaughlin, of New York; Mr. J. M. Orford, Bridgeport, Conn; Geo. L. Wiley, New York, and George Cutter, Chicago.

Ex-President Wm. J. Denver favored and entertained the members Monday evening, March 24, with an instructive paper, entitled "Induction and Interference with Telephone Service from Electric Light Circuits, from a Telephonic View."

Mr. Denver being absent from the city, having been unexpectedly called to Springfield on business, his paper was read by Mr. John C. Wilson.

It proved one of the most interesting and argument-provoking documents ever presented to the Club. In Mr. Denver's characteristic style, the terrors and annoyances of "Induction" to the telephone service was pictured in a graphic manner. The paper read before the Electric Club, of New York, by Mr. J. J. Carty, on a similar subject, was quoted from.

The reading of the paper was followed by a lengthy discussion.

Chicago Electric Club.

Lunches at the Club rooms are as popular as ever, and a visitor to the city who finds his way to the rooms in Adams street at noon is sure to meet a number of Chicago's representative electrical workers.

The Members have been well pleased with the lectures given this season. They have been instructive and interesting, and have been generally discussed.

The Club has received many compliments over the excellent entertainment provided on the occasion of the recent Electric Light Convention. The lunch so generously provided on that occasion by the members of the Club was evidently greatly enjoyed by the Eastern visitors, who were thus given an opportunity to sample Western hospitality.

Atlanta Electric Club.

Officers Elected.—At a meeting of the Atlanta Electric Club, which was held March 18, at the office of the Georgia Phonograph Company, the following officers were elected unanimously to serve one year: Mr. J. M. Stephens, president; Howard E. W. Palmer, first vice-president; W. T. Gentry, second vice-president; F. E. Clarkson, treasurer; H. H. Jackson, secretary. A board of managers was also chosen, as follows: F. E. Clarkson chairman; J. H. Wade, W. T. Gentry, W. J. Cole, J. M. Hollis. Committee on membership: L. B. Nelson, George Thompson, G. M. Moore. All the members present signed the constitution and by-laws, paid their initiation fees, and one month's dues in advance.

The Board of Managers are now employed in looking for suitable quarters, and every member feels sanguine of the success of the enterprise. The charter membership list now numbers 56, and the constitution and by-laws will be at the office of the Georgia Phonograph Company for the next 30 days, to be signed by absent members,

The Minutes of the meeting were recorded on an Edison phonograph.

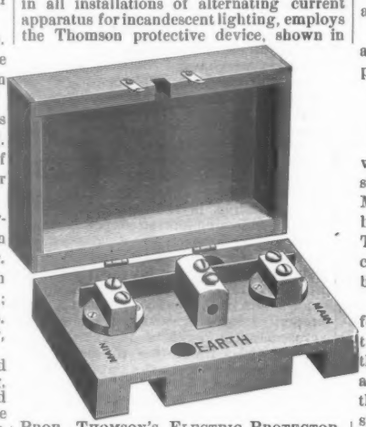
Clubs in Other Cities.

The cities of Kansas City, Milwaukee, Philadelphia, etc., have their electric clubs and societies, and will be fully represented in these columns as matters of interest occur. The members of the Kansas City organization were very active in making the visit of the electric light men to their city, recently, a pleasant one.

The Thomson Protective Device.

It is unquestionably a fact that high potential alternating currents can be handled without danger to life or property if the proper precautions are exercised. Sensational articles in the daily press have done much to prejudice the public against electricity in general and the alternating current in particular; and while these extravagant paragraphs cannot be backed up with facts, it is useless to maintain that high potential currents can be handled with impunity. The only proper practice is to use such care and safety appliances in construction as will eliminate all danger of accident or injury.

The Thomson-Houston Electric Company in all installations of alternating current apparatus for incandescent lighting, employs the Thomson protective device, shown in



PROF. THOMSON'S ELECTRIC PROTECTOR.

the accompanying illustration. It is claimed to be a simple but effective appliance, for absolutely removing the possibility of accident which might arise from contact with the secondary circuit. There are three conditions which must be simultaneously satisfied before this possibility can be said to exist.

1st. There must be a ground on the primary wires.

2d. There must be a contact between the primary and secondary coil in the transformer.

3d. The person must be in contact with the secondary and the earth at the same time.

The fulfillment of the first of the above conditions is of common occurrence, but the presence of a ground can be easily detected, and means can be at once taken to remedy the trouble. The second condition is met with seldom, and is only liable to occur when transformers are injured or subjected to rough usage in shipment. The third condition rarely obtains.

The remoteness of liability to accident is quite apparent when it is remembered that these requirements must be simultaneously satisfied, and even then, the extent of the injury depends upon the relative position of the contacts, with reference to the two primaries.

As the fulfillment of the above conditions is, of course, not beyond the range of possibility, the device herewith described has been designed to prevent any injury resulting from a contact with the secondary wires, when these requirements are fulfilled. It consists of three brass terminals, to the central one of which is rigidly attached a flat brass spring, pressing against the two outside terminals, but nominally held out of contact with them by slips of Thomson paper film. This paper film is very carefully prepared, so that it readily withstands the pressure of the spring, but is instantly ruptured when the first and second conditions, mentioned above, are satisfied. To the central terminal is attached, by means of a binding screw, a wire connected with the earth. To the inside terminals the secondaries are led directly from the transformer. When the difference of potential between the earth, with which the brass spring is in contact, and either one of the outside terminals, to which the secondaries are attached, should rise beyond the normal pressure, the paper film is at once punctured. This results in short circuiting the secondary, which causes the fuse to blow, thereby cutting out the entire installation.

A Successful Man's Opinion.

John Wanamaker says: "I never in my life used such a thing as a poster, or dodger, or handbill.

"My plan for 15 years has been to buy so much space in a newspaper and fill it up with what I wanted. I would not give an advertisement in a newspaper of 500 circulation for 5,000 dodgers or posters.

"If I wanted to sell cheap jewelry or run a gambling scheme I might use posters, but I would not insult a decent reading public with handbills. The class of people who read such things are poor material to look to for support in mercantile affairs.

"I deal directly with the publisher. I say to him: 'How long will you let me run a column of matter through your paper for $100 or $500?' as the case may be. I let him do the figuring, and if I think he is not trying to take more than his share, I give him the copy.

"I lay aside the profits on a particular line of goods for advertising purposes. The first year I laid aside $3,000; last year I laid aside and spent $40,000. I have done better this year, and shall increase that some, as the profits warrant it.

"I owe my success to the newspapers, and to them I shall freely give a certain profit of my yearly business."

Mill Tramway at Lawrence, Mass.

The fact that electricity can be used to advantage for mill tramways is shown in the installation at the Washington mills, Lawrence, Mass., which has recently been completed by the Thomson-Houston Motor Company. The tramway is used exclusively for carrying coal from the coal pockets to the boiler room, a distance of about 400 feet.

The track is level the entire length, and for the most part straight, there being but two curves—an S curve just after leaving the coal pockets, and a similar one through a less sharp turn where the track enters the boiler house. In the electrical construction the overhead system has been used, brackets being employed to support the trolley wire, which runs in height from 12 feet where all is clear, to six feet where the track passes underneath a belt box between two of the mill buildings, the springs on the trolley arm being so adjusted as to maintain an even pressure of the trolley against the conductor, irrespective of its height.

The current for the operation of the motor car is supplied from a 110 volt dynamo which is used for mill lighting, the rails and a supplementary ground wire being used for the return circuit. The car equipment consists of one ordinary dump coal car, and one platform car provided with one 3 horse-power 110 volt series wound motor, geared to the car axle, and capable of developing sufficient power to haul a load of 5,000 pounds, at the rate of six miles an hour.

At one end of the car are placed two levers, one for the special type rheostat used for governing the motor, the other for the reversing switch. Both of these as well as the brake handle are under the immediate control of the operator who stands upon the platform in front. The floor of the car is made so that it can be readily removed to allow an easy inspection of the motor and appliances, which, though covered with a thick coating of coal dust at all times, have not failed to operate satisfactorily since the tramway was first put in operation.

Asking for a Receiver.

Oliver J. Geer and D. Fahnestock, as mortgage trustees, have brought suit in the Supreme Court against the Electric Accumulator Company to have a receiver appointed, and to restrain stockholders from interfering with the company's property. Several years ago the company executed a mortgage for $1,000,000 upon its New York and New Jersey property and its patents, to secure first mortgage bonds, which have been issued to the amount of $957,400. Default has been made in the redemption of the interest coupons of June and December, 1889.

The Dubuque, Iowa, Electric Railway, Light and Power Company, of Boston, has given a deed of trust to the Bay State Trust Company, of Boston, to secure $285,000 first mortgage bonds.

KINDRED INTERESTS

The Duralite Manufacturing Company, of Leominister, Mass., have their Boston office at 85 Water street. This company makes a perfect insulator, which is taking the place of rubber in every form in which the latter has been used in electrical apparatus.

Charles A. Schieren & Company, through their Philadelphia house, have taken an order of the Louisiana Electric Light Company, at New Orleans, for 160 feet 72-inch double belt, and 550 feet 48-inch double belt. These belts will require the hides of more than 600 head of cattle.

Perkins Lamp Company.—This Hartford Company, which manufactures the Perkins incandescent lamps and sockets, is meeting with remarkable success, and in the past has found it difficult to keep up with orders, though working nights nearly all winter. Increased facilities at the factories will hereafter enable the company to turn out larger quantities of this popular lamp.

Brown & Sharpe's New Catalogue.—We have received a copy of the new edition of this catalogue just issued, and it is now ready for distribution. A list of new tools, changes in prices, and various other announcements of general interest, are shown on the colored insets. A handsomely engraved card, presenting a fac-simile of the gold medal won by this company at the Paris Exposition, is sent with the catalogue.

The Laminar Fibre Goods Company, 181 Summer street, Boston, manufactures materials and articles for electrical insulation and for mechanical purposes, requiring strength and resistance to wear and tear. Mr. T. S. Hanna, superintendent of the company, is said to be the originator and promoter of the fibre interests in this country. The company's manager, Mr. C. H. Whall, was upwards of five years the manager of the Leatheroid Novelty Company, of Boston, and enjoys a large acquaintance among the electrical men of this country.

The Weston Electrical Instrument Company has taken the four-story brick factory, at the corner of Shipman and William streets, Newark, N. J., and it is being fitted up for the manufacture of Mr. Weston's electrical measurement instruments, which he has been most successfully manufacturing for several years at his laboratory, and which have been, to a large extent, adopted as standard instruments. Mr. Weston has started on a trip through New England, and will visit the Brown & Sharpe Works, Pratt & Whitney's, The American Watch Company and other large establishments, in quest of the latest and best machinery for his purpose.

The Clark Electric Company, 192 Broadway, New York, are receiving a good many orders and inquiries for their arc lamp to be used on continuous incandescent currents. These lamps have been in use for over a year at Columbia College, New York, giving perfect satisfaction. As the electro-motive force is always constant, the length of the arc is maintained without perceptible variation, consequently the light is perfectly steady. While the lamps possess great illuminating power, the light is soft and not disagreeable to the eyes. There is no flickering or noise in its operation. The value of a reliable lamp for this service is the more appreciated, as the demand increases for interior arc lighting. The arc light is thus placed within the reach of all who from lack of space or other causes cannot operate a high tension system.

The Russell Electric Lamp Company is organized for the manufacture and sale of the Russell electric arc lamp. It is claimed that with one set of carbons it will burn 18 to 24 hours, consuming 16 inches of carbon. The upper carbon is in the form of a disk, about 4½ inches in diameter. The lower carbon is in the ordinary pencil form, about 14 inches long. In the two carbons a saving is made of two inches of carbon resistance, making a corresponding saving of electric current, while the light is equal to that of any arc lamp of 2,000 candle-power. The advantages claimed for this lamp are the considerable saving effected by its burning twice as long as the ordinary arc lamp without having the carbons renewed, thus saving the labor and expense of supplying a set of carbons for renewal. The cost of the lamp is not greater than that of the ordinary arc lamp. It is shorter and can be used in low studded rooms when the ordinary arc lamp reaches down too low. The economy and advantages here enumerated will make it for the interest of all who have use for electric arc lamps to investigate the Russell lamp.

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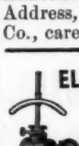

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON MARCH 25, 1890.

423,879 Constant current motor; William Baxter, Jr., Baltimore, Md.

423,901 423,902 Multiplex synchronous telegraph. 423,903 Synchronous multiplex telegraphy; Robt. G. Brown, Brooklyn, N. Y.

423,907 Process of separating magnetic particles; Gordon Conkling, Glens Falls, N. Y.

423,909 Regulator for dynamos; Henry W. Cooley, Boston, Mass.

423,913 Commutator brush; Philip Diehl, Elizabeth, N. J.

423,956 Electric forging machine; Robert Ross, Vergennes, Vt., assignor of five-eighths to John I. Gilbert, Malone, N. Y., and Eliza J. Ross, administratrix of said Robert Ross, deceased.

423,959 Therapeutic galvanic apparatus; Theodore Schmauser, Allegheny, Pa.

423,965 Electric valve controller. 423,966 Method of electric soldering, cementing, etc. 423,967. Apparatus for electric soldering and cementing; Elihu Thomson, Lynn, Mass.

423,975 Controller for electric motors; Merle J. Wightman, Lynn, Mass., assignor to the Thomson-Houston Electric Co., of Connecticut.

423,991 Dynamo electric machine; Sebastian Z. de Ferranti, Hampstead, County of Middlesex, England.

424,006 Telegraphy; Charles Langdon Davies, London, England, assignor to the Phonophore Syndicate, Limited, same place.

424,012 Electro-medical chair; Marian A. MacMaster, Utica, N. Y.

424,036 Electro-magnetic motor; Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

424,047 Electric radiator; Henry R. Butterfield and Willis Mitchell, Waterville, Me., assignors to the Butterfield & Mitchell Electric Cooking and Heating Co., same place.

424,057 Underground conduit for electric wires or cables; Chas. G. Gilman, Eldora, Iowa.

424,065 Dynamo electric machines; Charles D. Jenney, Indianapolis, Ind.

424,070 Electric locomotive; Geo. W. Mansfield, Boston, Mass.

424,082 Electric railway; Walter Thompson, Meriden, Conn.

424,110 Coupling for trolley wires; Samuel Harris, Cleveland, Ohio, assignor to Tom. L. Johnson, same place.

424,152 Secondary battery; Harry H. Wardwell, Lake Village, N. H.

424,182 Circuit closer; Joseph A. Dempf, Washington, D. C.

424,206 Electric railway car. 424,207 Electrically propelled vehicle; Rudolph M. Hunter, Philadelphia, Pa.

424,209 Quadruplex relay; Francis W. Jones, New York, N. Y.

424,219 Electric alarm for letter boxes; Wesly G. Reed, Toronto, Ontario, Canada.

424,233 Lubricant; Fred. E. Swain, Chicago, Ill.

424,268 Electro-magnetic watch clock; Rufus B. Can, Boston, Mass., assignor of one-half to Albert Howard, same place.

424,273 Electric time dial; Chas. A. Colby and James C. Strong, Buffalo, N. Y.

424,295 Electric stop motion for knitting machines; John P. Haslam, Wilmington, Del., assignor of three-fourths to Francis E. Gallagher, Samuel L. Foster and John T. Ahrens, all of same place.

424,298 Electric railway; John C. Henry, Kansas City, Mo.

424,310 Multiple switchboard; Milo G. Kellogg, Hyde Park, Ill.

424,338 Electric meter; William McKinney, Philadelphia, Pa.

424,339 Isolated system of electric lighting. 424,340 Electric railway; Jas. F. McLaughlin, Philadelphia, Pa.

424,363 Thermostat; Wm. F. Singer, Carthage, assignor to the Singer Fire Alarm Co. of Buffalo, Limited, Buffalo, N. Y.

424,364 Electric railway; Edmund P. Slentz, Idlewood, and Jas. B. McGrew, Pittsburgh, assignors of three-eighths to John A. Smee, Pittsburgh, Pa.

424,371 Removable truck for electric cars. 424,372 Electric car truck. 424,373 Electric car truck frame. 424,374 Trolley bridge; John Stephenson, New York, N. Y.

424,380 Combined conduit and overhead system for electric railways; Chas. J. Van Depoele, Chicago, Ill.

424,381 Trolley arm for electric railway cars; Chas. J. Van Depoele, Lynn, Mass.

424,401 Electric meter; William J. Bagby, Atlanta, Ga.

424,403 Electric heating and cooking device; Henry R. Butterfield, Waterville, Me., assignor to the Butterfield & Mitchell Electric Cooking and Heating Co., same place.

424,404 Electric flat iron; Henry R. Butterfield and Willis Mitchell, Waterville, Me.

424,406 Commutators; William F. D. Crane, Philadelphia, Pa.

424,423 Implements for tying the ends of wire; Chas. W. Lampher, Norwich, assignor of one-half to John B. Kew, New York, N. Y.

424,436 Electric railway motor; Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Railway and Motor Co., same place.

424,441 Method of manufacturing projectiles by electric welding. 424,442 Projectiles; William M. Wood, Washington, D. C., assignor to the Thomson Electric Welding Co., Boston, Mass.

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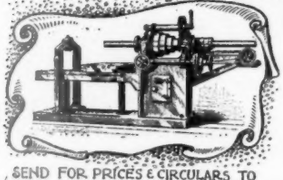

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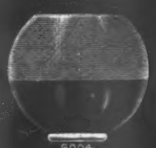
GLOBES  SHADES

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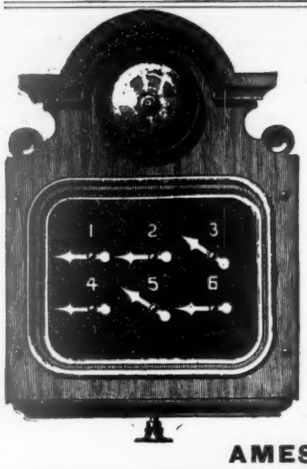

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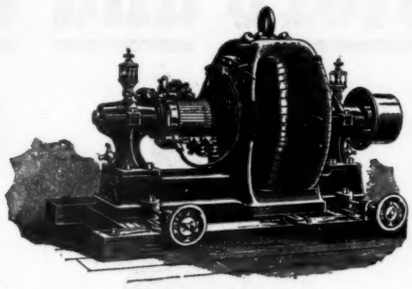

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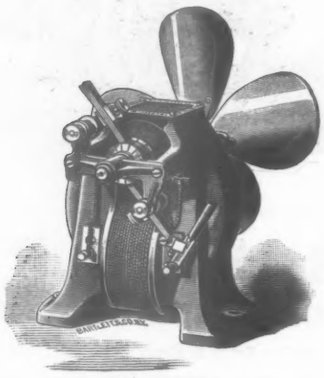

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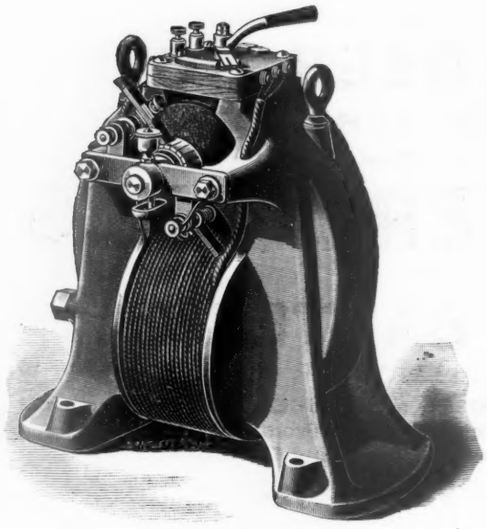

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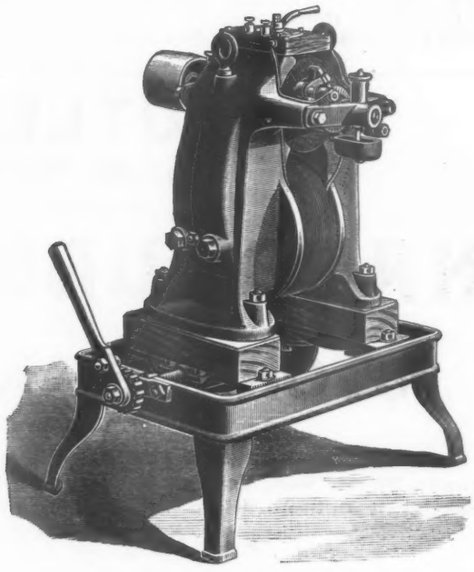

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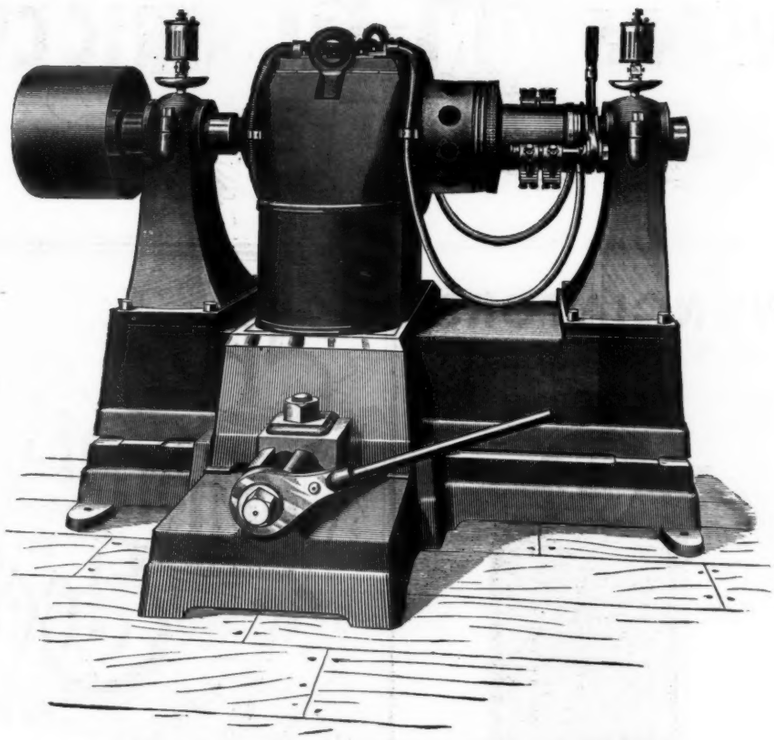

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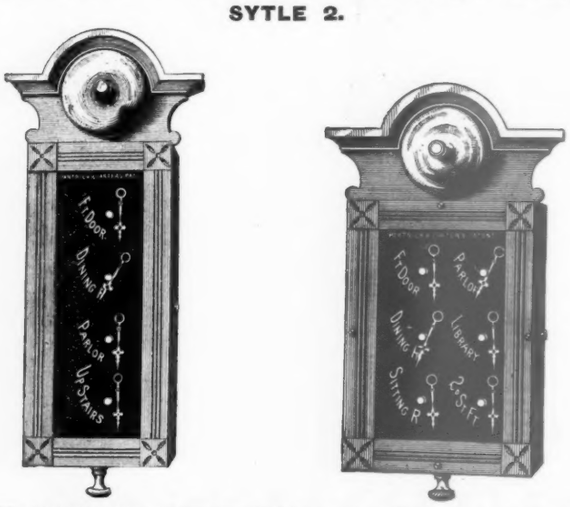

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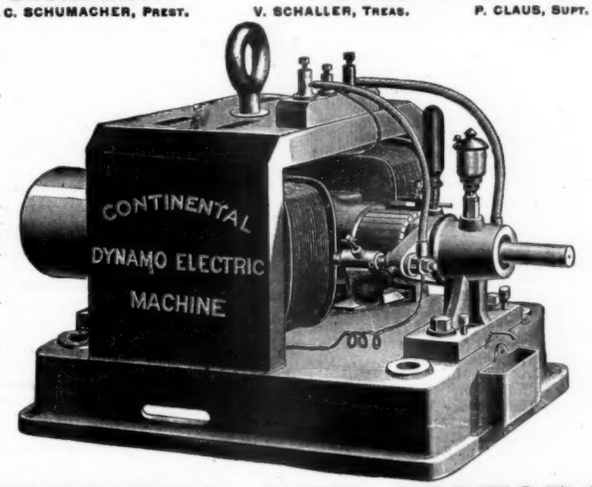

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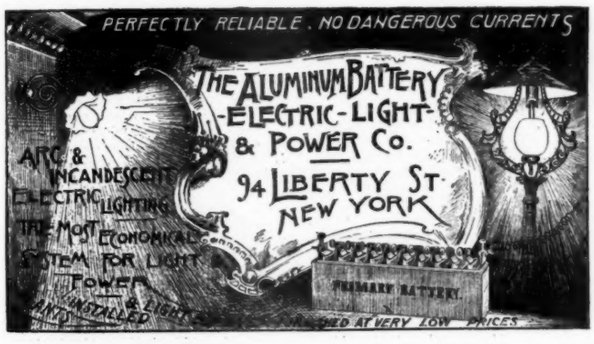

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C	8	.....	.....	.....	6.5	1¼	5,000 FEET PER MINUTE.	530
C	.....	10	.....	.....	6.5	1½		530
E	.....	.....	.....	25	8.0	2		530
E	16	.....	.....	.....	12.0	2½		780
C	.....	20	.....	.....	12.5	2½		780
T	.....	.....	26	.....	13.0	2½		780
R	20	.....	.....	.....	15.0	3		990
I	.....	25	.....	.....	15.6	3		990
C	.....	.....	32	.....	15.0	3		990
I	.....	.....	.....	50	16.0	3		990
T	28	.....	.....	.....	21.0	4½		1,360
Y	.....	.....	.....	.....				

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C	.....	35	.....	.....	21.0	4	5,000 FEET PER MINUTE.	1,360
C	.....	.....	45	.....	21.0	4		1,360
H	.....	.....	.....	70	21.0	4½		1,360
H	40	.....	.....	.....	29.7	6		1,750
I	.....	50	.....	.....	30.0	6		1,750
H	.....	.....	64	.....	29.5	6		1,750
I	52	.....	.....	.....	38.0	8		2,290
J	.....	65	.....	.....	38.6	8		2,290
K	.....	.....	83	.....	38.0	8		2,290
J	64	.....	.....	.....	46.5	10		2,770
K	.....	80	.....	.....	47.1	10		2,770
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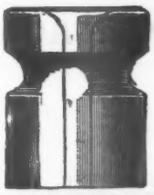

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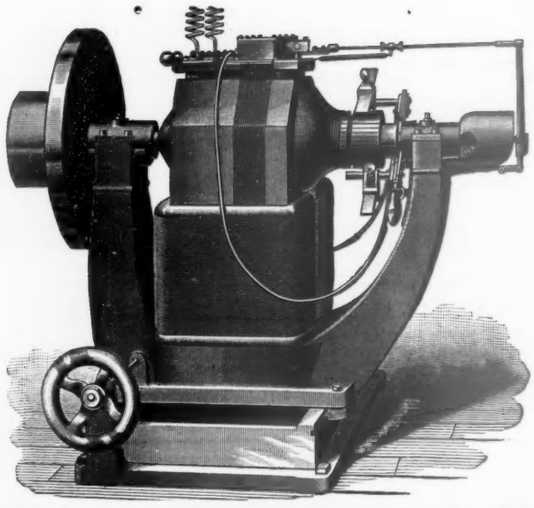

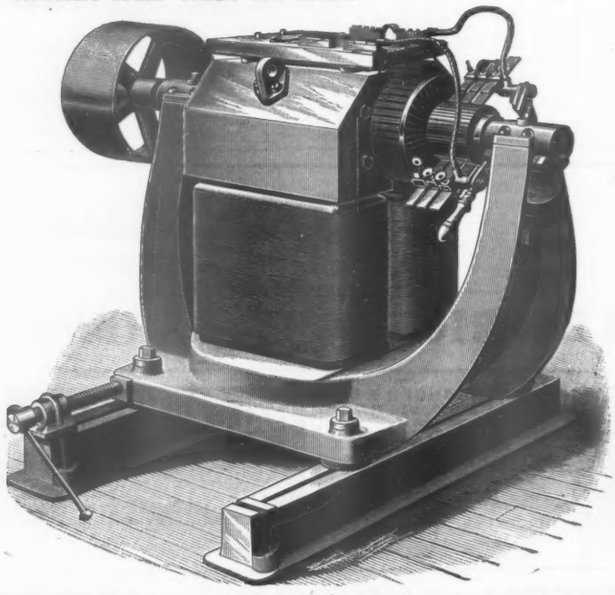

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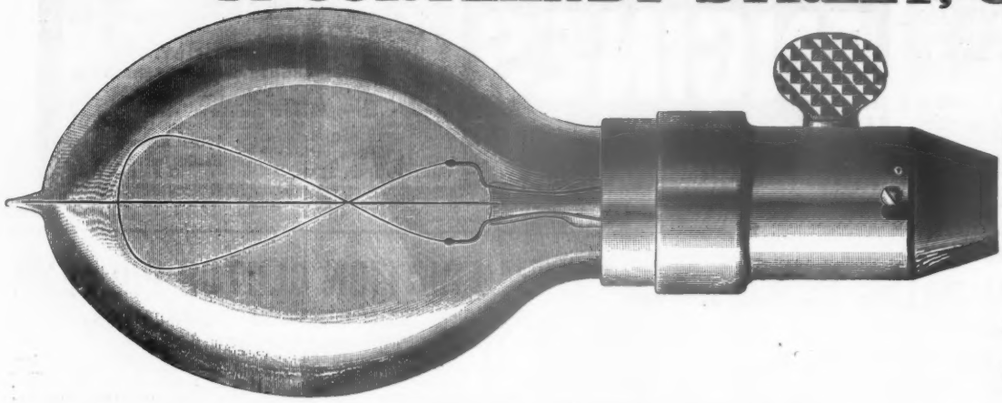

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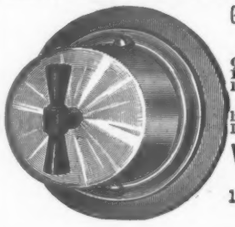

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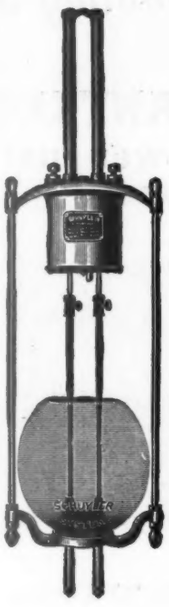

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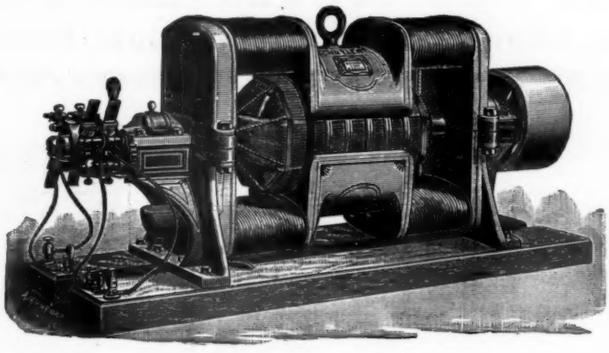

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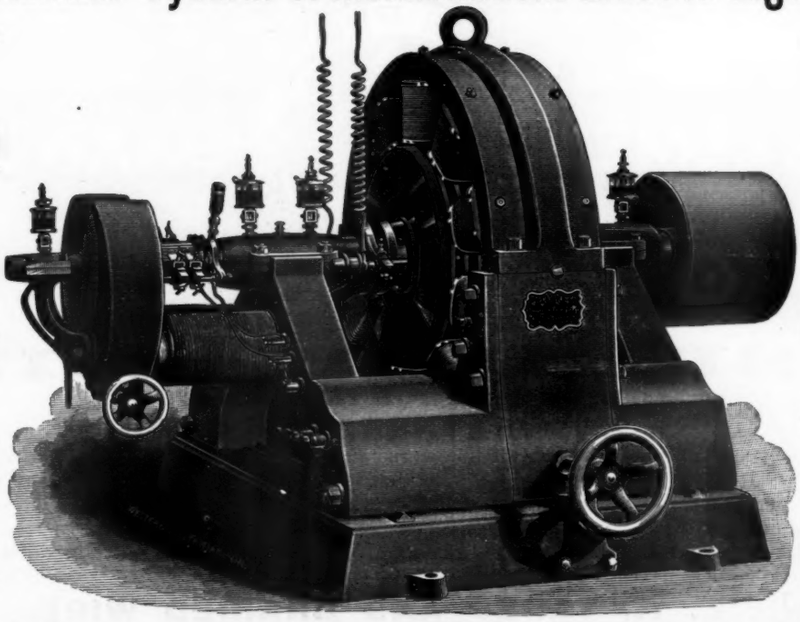

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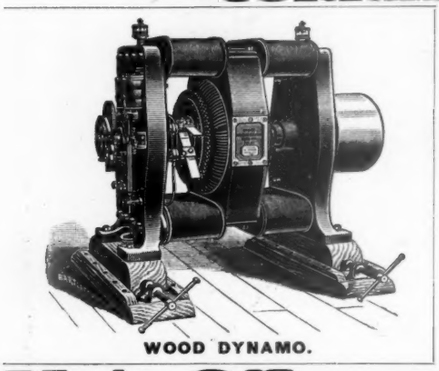

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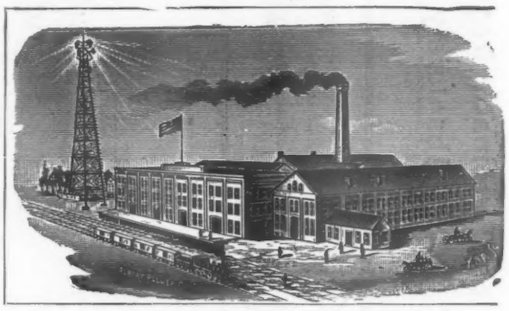

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The covering consists of: An insulation, a saturated braid, two uncured rubber tapes wound in opposite directions, an insulation, a braid and a weather proof finish. This is one of the best insulated wires ever offered to the trade.

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